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CRAWLER CRANES ON BARGES built of Navy pontoon units furnish needed equipment for floating operations on Saco River Bridge, one of two major crossings on $20,000,000, 44-mile section of Maine Turnpike. See story page 26.

EJC Survey on Economic Status of Engineers

Maine Superhighway Has Latest Design Features

Power and Irrigation Potentials of Colorado River System

Research, Costs and Future of Construction Industry

DULUTH MEETING
DIVISION REPORTS
Page 13

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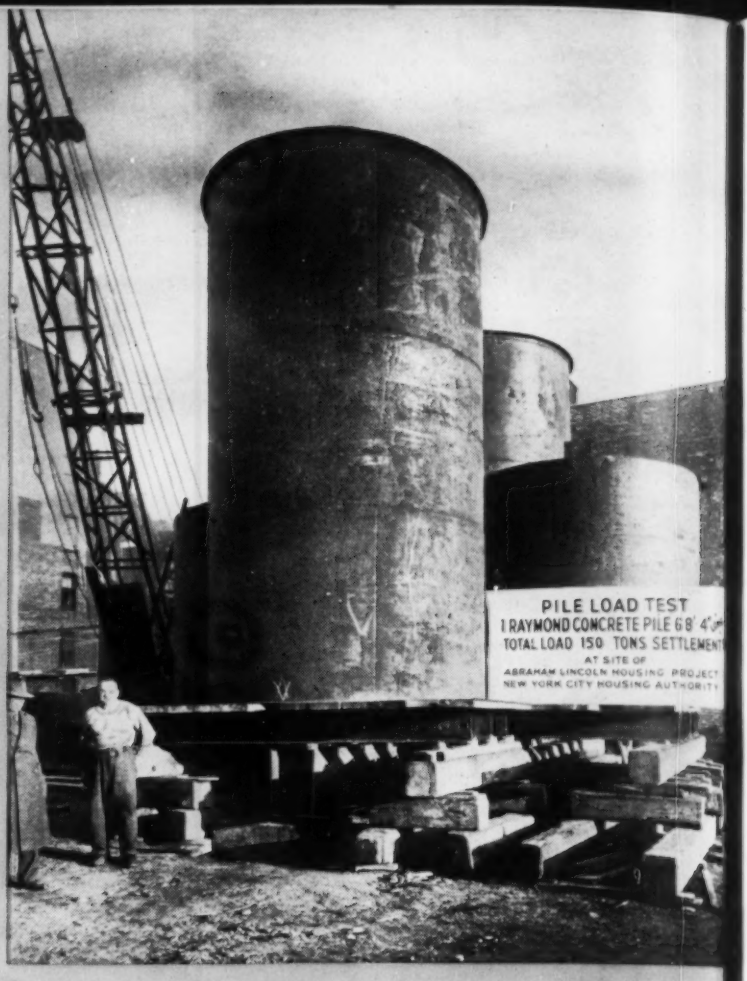
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AUGUST 1947
Volume 17 Number 8

CIVIL ENGINEERING

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• In This Issue

"The Engineering Profession in Transition," Report on Economic Status Survey . . . *William N. Carey* 13
The Engineer in Building for Peace . . . . *E. M. Hastings* 16
Construction Division Papers Highlight ASCE Summer Convention in Duluth . . . 17
New Orleans Plan Includes Union Passenger Terminal . . . 25
Privately Financed Superhighway in Maine Incorporates Latest Design Features . . . *R. N. Bergendoff* 26
New $2,000,000 Cancer Institute . . . 30
Proposed Projects Develop Power and Irrigation Potentials of Colorado River System . . . *H. F. McPhail* 31
Crane Serves as Materials Elevator . . . 35
Duluth Papers Discuss Subjects Vital to Construction Industry . . . *J. C. Stevens, A. O. Babb, F. W. Parrott* 36
Plow Train Simultaneously Digs Trench, Lays Telephone Cable . . . 45
Politics Needs Engineers . . . *William Goldsmith* 46
Wrought-Iron Plates Prevent Fire Spread . . . 47
Santee Cooper Generating Plant Completes Five Years of Service . . . *F. A. Dale* 48
First Unit of Modern Building Research Center . . . 49
Assembly-Line Methods Produce 1,200 Low-Cost Homes in Maryland . . . 50
Survey Shows Need for Eight-Billion-Dollar Expenditure on Water Supply and Waste Disposal . . . 51

• Society News

The President's Message . . . 57
Survey of Engineers Is Approved by ASCE Board . . . 57
Ballot on Dues Increase, Vote for Juniors Authorized at ASCE Convention . . . 58
Duluth Convention Pictures . . . 59
Members Named for EJC Consultative Committee . . . 60
Richard E. Dougherty Is Nominated for President . . . 61
News of Local Sections . . . 61
Student Chapter Notes . . . 65

• Departments

Engineers' Notebook . . . 53
The Readers Write . . . 55
News Briefs . . . 66
N. G. Neare's Column . . . 69
Wool Gatherings . . . 69
New in Education . . . 71
New Publications . . . 71
News of Engineers . . . 72
Deceased . . . 74
Recent Books . . . 86
Changes in Membership Grades . . . 88
Applications for Admission . . . 92
Men and Jobs Available . . . 100
Literature Available . . . 112
Equipment, Materials, Methods . . . 106
Index to Advertisers . . . 116

Original Woodcut by Lynd Ward

The life of a supply line, to be constructed with cast iron pipe, is obviously more predictable than the future growth of the community it is to serve. City planners may hazard a prediction of population growth in a hundred years. Water works engineers can predict, on the basis of proved service records, that a properly constructed cast iron supply line will have a useful life of *more* than a century. A substantial part of the tonnage of large diameter cast iron pipe, installed for supply lines throughout America, is U. S. Cast Iron Pipe.

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"The Engineering Profession in Transition" Report on Economic Status Survey

WILLIAM N. CAREY, M. ASCE
Executive Secretary, American Society of Civil Engineers

"THE ENGINEERING PROFESSION in Transition," as its author, Andrew Fraser, the consultant engaged by the Engineers Joint Council Committee on Survey of the Engineering Profession, has titled the 1946 survey on economic status of the profession conducted by the committee, is being printed. When this revealing and important self-analysis of the engineering profession is published, it will be available for general sale at $1.00 per copy. To ASCE members, the complete report will be available at 50 cents from the Executive Secretary of the Society.

In this article, Colonel Carey, chairman of the EJC committee that conducted the survey, sets forth salient points uncovered in the project, which dates back to 1945 when committee work first was begun. Of particular interest in this study, restricted for the first time to persons identified through their membership in the six national professional engineering societies as being qualified members of the profession, are the comparisons afforded for the before, during, and after the war years of 1939, 1943, and 1946. The participating societies are: ASCE, AIME, ASME, AIEE, and AIChE, which make up the Engineers Joint Council, and NSPE, joining in this project by invitation of EJC.

IT BECOMES increasingly apparent that the 1946 survey of the engineering profession, now being published in an 80-page 9 × 12-in. EJC Bulletin under the title, "The Engineering Profession in Transition," will be a most valuable and interesting document to those in the profession. Dealing with the general and specific factors that affect engineers' employment opportunities and designed to establish relationship of earning capacity to these individual factors, the report covers the topics of geographical location, general field of employment and industry field, and includes a wide range of occupational statuses. Completion of the report marks a milestone of accomplishment in the cooperative professional activities of Engineers Joint Council. It furnishes the profession with up-to-the-minute economic status data based on answers to questionnaires sent to 87,000 professional engineers, all members of the six national engineering societies participating in the project.

Compilation of the report represents an expenditure by the engineer society group of $16,000 and more than that amount in addition in value derived through the cooperation of the Bureau of Labor Statistics, U. S. Department of Labor, which furnished staff and equipment for tabulating returns from the pre-coded questions. All members of the survey committee were called upon to give freely of their time to the project. In round numbers, the completed manuscript represents expenditures approximating a $50,000 total. These expeditures brought the report to the finished manuscript stage. Printing will be an additional expenditure to be met by the societies or by individuals desiring printed copies of the report.

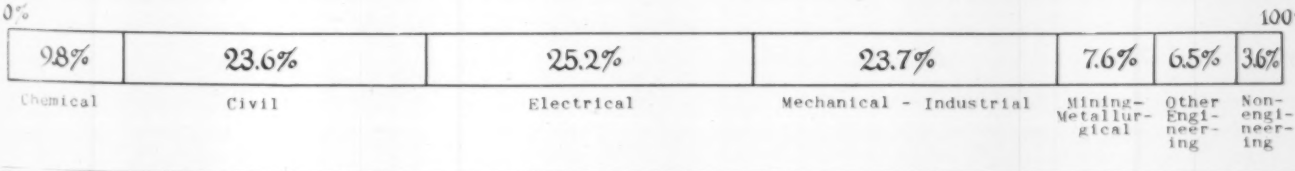
In the space allotted here it is only possible to present some of the more immediately interesting conclusions reached on the basis of replies received to the questionnaires, on which there was a 53 percent return. The report must be read in its entirety for an appreciation of the completeness and clarity of the wealth of statistical information covering the engineering profession there presented.

A marked change occurred in the ratio between the earnings of the older and the younger members of the engineering profession over the period 1939 to 1946. In 1939, private graduate employees with 35 to 39 years experience earned a median salary of $550 a month, which is nearly $4\frac{1}{2}$ times greater than the median $127 a month for newcomers to the profession in that year. In 1946 the corresponding difference in median salaries in this same grouping was $629 to $232, a ratio of $2\frac{3}{4}$ to 1 as against $4\frac{1}{2}$ to 1 in 1939.

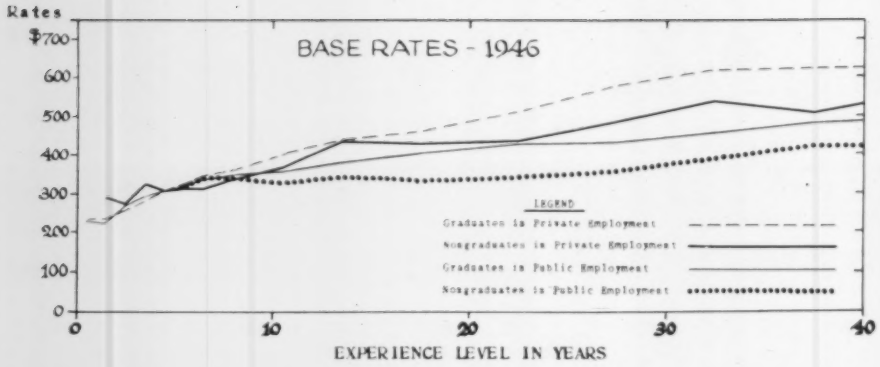
The report also establishes clearly that graduate engineers earn more than nongraduate engineers at all experience levels except for the first six years. Consistent with this is the fact that those with Master's degrees earn more than those with Bachelor's degrees, and graduates with the degree of Doctor enjoy still higher earnings.

Another significant development is that the monthly salary rates structure of the engineering profession in 1946, with overtime payments no longer a factor, was not only much higher than that of 1939, but also exceeded the base-plus-overtime range of 1943. Further, this improved earnings status in 1946 was common to engineers in all general fields of employment, whether graduates or nongraduates and in both private and public engineering.

Younger engineers reported the greatest relative increases. For newcomers to the profession in 1946 the improvement was of the order of 88 percent reflecting median monthly salary rates of $231 a month for 1946 as against $128 a month in 1939. Men with 6, and 12 to 14 years' experience received median rates in 1946 of $343, and $385 a month or, respectively, 60 and 33 percent more than similarly experienced engineers had received in 1939.



PERCENTAGE DISTRIBUTION of the engineering profession in 1946, by general field of employment.



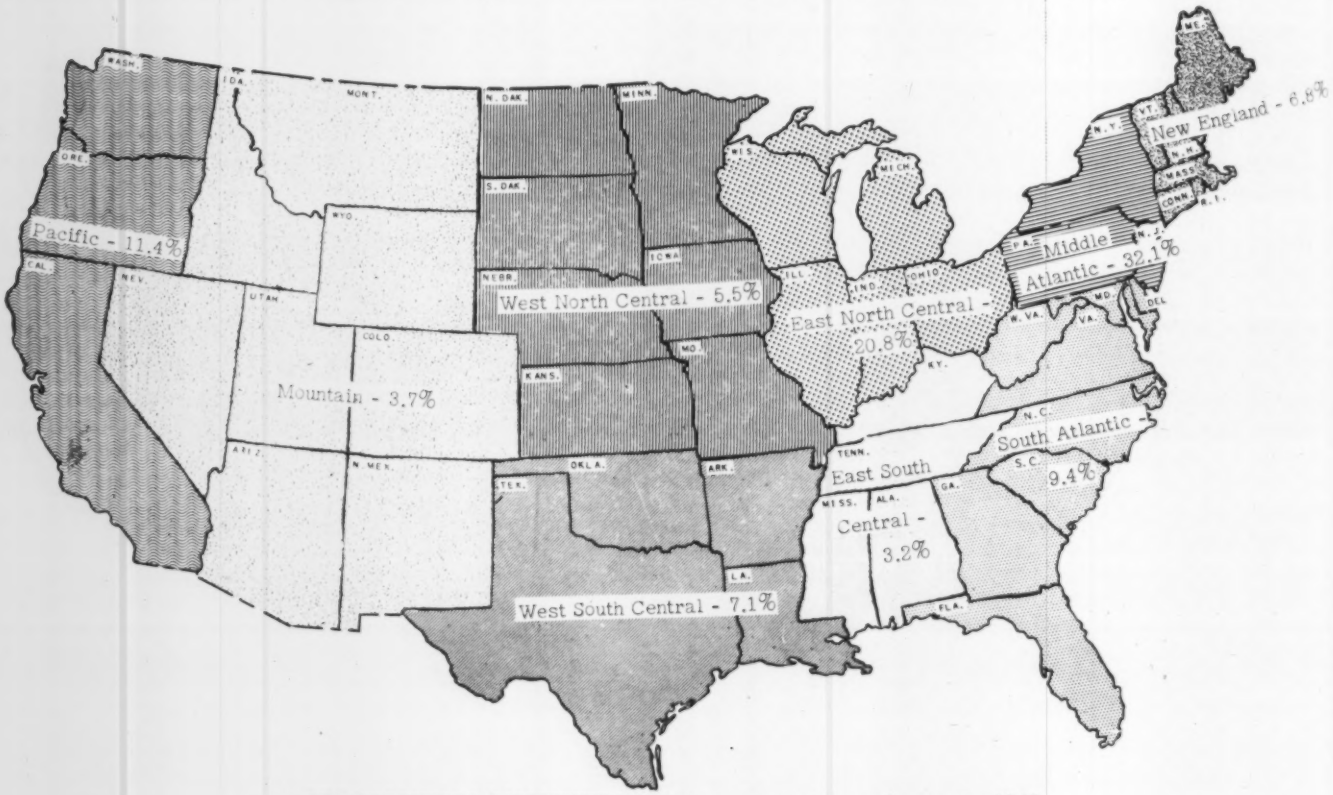
MEDIAN BASE and base plus overtime monthly salary rates of graduate and nongraduate engineers in private and public employment in 1946, 1943, and 1939.

Interesting data are revealed in the report regarding the differential which begins to assert itself between graduate engineers and non-graduates after the first 6 years of experience. During this period, as has been stated, the differential is negligible. At the 9 to 11 years' experience level in 1946, engineers with Bachelor's degrees reported median earnings of $389 a month, whereas engineers with incomplete college courses or no college education reported, respectively, $363 and $374 a month. By contrast, while Masters earned $409 a month, Doctors earned as much as $466 a month. Significantly, at higher experience levels, the earnings' advantage in favor of graduates becomes more and more pronounced.

The report shows that the profession in 1946 was not a "closed shop" for graduates only. This is evidenced by the fact that 17 percent of all engineers reporting included men who had incomplete college training or none at all. Bachelors degrees were held by 64 percent, while 15 percent reported graduation at the Master's level and 4 percent were Doctors.

Really significant differences in engineers' earnings begin to appear only beyond the 8 years' experience span (i.e., 31 years of age). The extent of these differences, as might be expected, depends largely on the general field of employment of the individual, educational qualifications, and occupational assignment. For example, in 1946, median base monthly salary rates ranged from $224 to $256 a month among 10 groups of newcomers to the profession, 6 groups engaged as employees in private and 4 in public engineering. By contrast, among the six private engineering groups the range in median rates earned by engineers with from 35 to 39 years' experience span was from $513 a month for Civil engineers to $825 a month for Chemical engineers. Second in ranking order came Mining-Metallurgical engineers with $693 a month, followed by $650 a month for men in "other engineering fields," Electrical engineers with $604 a month, and $587 a month in the case of Mechanical-Industrial engineers. This steady progression in earning capacity with advancing years of experience also is characterized by a persistent and substantial spread in earnings at every experience level. This spread becomes particularly accentuated in the upper 10 and 25 percent earnings groups.

The composition of the profession in 1946 by general field of employment showed nearly 73 percent about equally divided among Civil, Electrical, and Mechanical-Industrial engineers. There were 10 percent Chemical engineers, 7 percent Mining-Metallurgical, 6 percent in other engineering fields, and the remaining 4 percent were engaged in non-engineering work. Except for civil engineers, whose work was divided approximately equally between public and private engineering, those in the other 6 fields were overwhelmingly dependent upon private engineering


Pacific - 11.4%
Mountain - 3.7%
West North Central - 5.5%
West South Central - 7.1%
East North Central - 20.8%
Middle Atlantic - 32.1%
New England - 6.8%
South Atlantic - 9.4%
East South Central - 3.2%

GEOGRAPHICAL DISTRIBUTION of the engineering profession in 1946.

for their employment. Nearly 60 percent of the country's professional engineers in 1946 were in the manufacturing and construction industries.

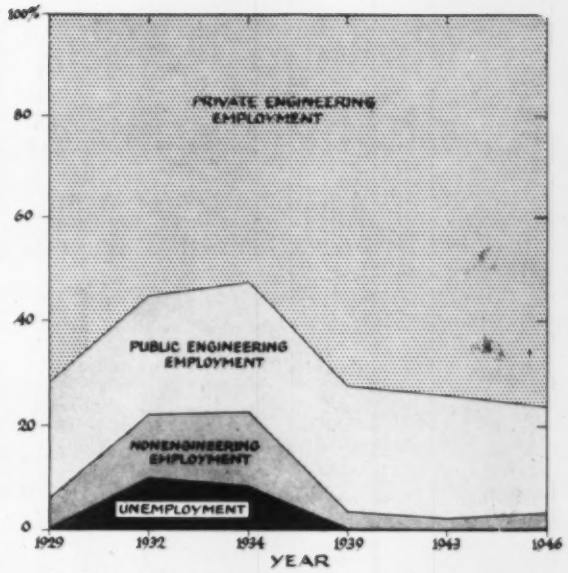
Among the 29 occupational statuses reported for 1946, nearly 30 percent of all engineers were engaged in technical administration-management. Design, development, and applied research attracted 15, 7, and 5 percent, respectively; supervisory construction, college or university teaching, private firm consulting, and sales each included from 4 percent to 5 percent. Among the remaining 21 statuses, the percentages ranged from less than 1 percent to 4 percent.

When related to each of the 29 occupational statuses, the median monthly salary rates among the newcomers to the profession in 1946 ranged only from $206 to $248. At the 6 years' experience mark, the range had increased from $280 to $378 a month. But at the 12 to 14 years' experience level, while engineers engaged in routine work, such as drafting, earned $310 a month in 1946, men engaged in non-technical administration-management earned as much as $555 a month.

The relationships found to exist between earned annual incomes reported for 1939 and 1943 only, and monthly salary rates in these same years, make it clear that the opportunity to earn substantially more than base salaries is confined to a very small and experienced segment of the profession.

An earnings differential pattern that persisted to the end of the active experience cycle of professional engineers is disclosed by the 1946 information. This begins at the 15 to 19 years' experience mark and indicates that, at the median earnings point, Civil engineers generally receive the lowest remuneration, not only in private engineering, but also in non-federal Government employment in public engineering. Furthermore, the earnings of engineers in private engineering employment exceed by far those reported for public engineering, with private Chemical engineer employees consistently reporting the highest remuneration at all experience levels.

While the median monthly salary rate for newcomers in the civil engineering field is the highest of all, it is the lowest at the 40-year experience level. The median rates of Civil engineers steadily increased from $243 for newcomers to $513 for men with 35 to 39 years of experience while engineers in "other engineering fields" increased from $224 to $650 a month. The corresponding range for Chemical engineers was from $256 to as high as $825. Between the two extremes came Mining-Metallurgical engineers with median earnings that increased at the same experience levels from $236 to $693 a month, and below the "other engineering" group, but above the Civil engineers, were the Electrical engineers, whose reported median earnings increased from $237 for newcomers to $604 at the 35–39 years experience level, and the Mechanical-Industrial engineers who had a corresponding experience span increase from $225 to $587 a month.



THE CLASS OF worker status of the engineering profession, 1929–1946.

Perusal of employee engineers earnings indicates that they must be modified when related to educational qualifications. For example, the median earnings of the graduate group in 1946 increased from $232 a month to $346 a month over the experience spans 1 to 6 years, whereas the median earnings of the comparable group of non-graduate engineers increased from $295 to $317 a month. At the 7 to 8 years' experience mark, non-graduate private employees earned $344 a month, but graduate private employees earned a median rate of as much as $365 a month. On the other hand, in public engineering, the earnings differential in favor of graduates does not assume statistical importance until the 9 to 11 years' experience level is reached.

As to World War II, the survey points up the fact that approximately 12 percent of all professional engineers in the country served in the Armed Forces. A break down of this figure indicates that the war effort required mining engineers and chemical engineers generally to remain in civilian status or, if in the Armed Services, to follow pursuits outside their professional fields. More Civil engineers served in their field in the Armed Services than any other group. The breakdown of professional engineers in the Services in World War II is: Civil, 29 percent; Mechanical-Industrial, 15 percent; Electrical, 14.7 percent; Chemical, 1.8 percent; Mining, 1.0 percent; other engineering, 14.2 percent; and non-engineering, 24.3 percent.

Comparisons also confirm what might be assumed, that the demands of the Services were for younger men. Apparently the Services utilized professional engineering skills to a high degree. The effects of demobilization were such that the patterns of disposition with respect to the class of worker and industry field were virtually the same in 1946 as had existed 7 years earlier in 1939. The changing pattern with respect to occupational status reflects the advance which occurred in engineers' overall economic status despite service either in the Armed Forces or as civilians. As to comparative earnings between engineers in the Armed Forces in 1943 and those who were civilians, the survey indicates that base median monthly rates were approximately the same at each respective experience level for the two groups.

A wealth of additional information is contained in the report which goes into employment opportunities by geographical location, general fields of employment. In this brief résumé, it has been attempted merely to present some indication of the magnitude and scope of the survey. As stated earlier, a reading of the full report is required for full appreciation of the completeness and clarity of the statistical information covering the engineering profession.

The report will do much toward increasing the tempo of studies and discussions on the need for reorientation of engineering education and practice which have been under way in many quarters. In short, the 1946 survey of the engineering profession, so aptly titled, "The Engineering Profession in Transition" is, to state it rather unprofessionally, the "where we have been" on the economic status of the engineering profession, which can serve as an important, factual guide to "where do we go from here?"

The Engineer in Building for Peace

Annual Address of the President Delivered at Duluth Convention

E. M. HASTINGS, PRESIDENT, ASCE

Chief Engineer, Richmond, Fredericksburg and Potomac Railroad Co., Richmond, Va.

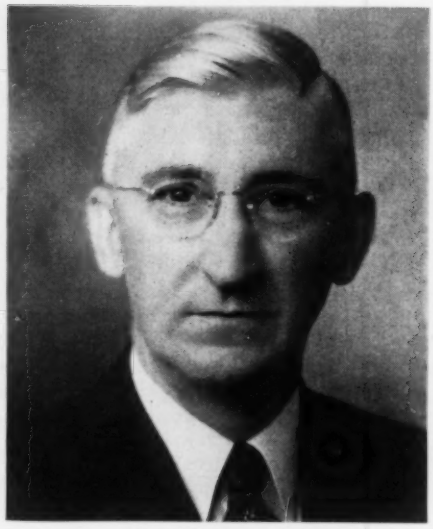
PAST-PRESIDENT STEVENS in his Annual Address in 1945 expressed the view that "The engineer will play a most important role in the revitalization of the world for peacetime pursuits." How many of the members of our Society today remember that most important statement? I am going to take it up and press forward with it now, two years after it was spoken, in an endeavor to direct attention to the things which to my mind are the most important tasks that have ever been given to any people.

The day is here when the creative mind of the engineer must be used for the revitalization of the world if we are to work our way out of the confusion that is almost universal. All too long has the engineering mind been content to channel itself in narrow and, in many respects, selfish ways. There has been much broadening in our public expressions and efforts recently, reflected to a degree in the activities of the Society in recent years and being given impetus in the actions being taken by the Society today. We are concerning ourselves about many things outside the purely technical field and gaining for ourselves a large and respectful following in the areas where our profession should make us the leaders.

The mind of the engineer is trained to weigh carefully the important and fundamental elements that inherently are found at the beginning of any great engineering project to be undertaken. Should not that mind be used in leadership to formulate policies for the guidance of men in the pursuit of enduring peace?

Is it necessary that we wait for power politics, so-called diplomacy or the might of certain nations to declare themselves for this or that solution before we go to work toward the building of the new and better world for which we so recently fought and for which we made so many sacrifices?

Our profession has contributed so many magnificent things conceived, designed and constructed for the comfort and welfare of mankind. That same profession also has been used for so many things that have been concocted to destroy and finally to wipe from the very earth large areas and unnumbered peoples. Now that we can see the magnitude of the destruction wrought by the last war, should we not face the future with a determination that such things shall not happen again?



E. M. Hastings, President of ASCE

Although we have destroyed great cities and have in our hands the knowledge and means to destroy greater areas and wipe out nations, please bear in mind that we have one thing that cannot be destroyed, and that is a national ideal. Ideals are indestructible; they will rise out of the debris and ashes of a war-torn world and point the minds and energy of men toward nobler and higher purposes than ever have been known before. That is what we in this Nation possess, the ideals of liberty and freedom. They form the foundation upon which our Nation is founded, and have been the banner that has guided us through the trials and dark days of the past; they have been the torch that has lighted the way to Victory and today they constitute a searchlight pointing the way to the revitalization of the world.

We engineers here in the United States of America cannot be content to wait for political diplomats to solve the problems; we must put our talents to work and enter wholeheartedly into the tasks of democracy that are now before us.

What is democracy? An American schoolgirl was asked this question. Her answer was, "It is what we have and are." Can you find a better definition than this? Look at what we have and are. I believe that our success as a nation stems from that which, through the years, we have set up here. I am a believer in private enterprise and can find no hope for the world in the philosophy of a Karl Marx. I am a believer in universal military training. We should make our position so strong, so just and so tempered with realistic generosity that we would gain the respect of the world. Such respect cannot be purchased from foreign nations with dollars.

Let the engineering profession then get into the affairs of the State, the Nation and the World as a profession that creates and revitalizes the factor for a world of peace. With all of our resources, our marvelous skill for the production of material things, our creative genius for new and better things, our great might and our power to command respect, it cannot be that we will be willing to let this year of opportunity pass with little or nothing accomplished to that end.

We of the engineering profession need to have for ourselves now the things that our young and virile America had when it fought for and won its independence and which our leaders have had in their ensuing struggles to maintain it. If we ever hope to persuade other nations to our way of life we must first recapture for ourselves the zeal, the courage, the eloquence and the inner spirit of the great men of our history who made it possible. Never for a moment dare we relax our vigilance. Always both from without and within our country, there are forces at work to destroy it. David Hume said, "It is

(*Continued on page 76*)

Construction Division Papers Highlight ASCE Summer Convention at Duluth

DESCRIPTIONS OF MAJOR construction projects and discussions of timely subjects of vital importance to the construction industry held the attention of many ASCE Members who attended the Society's Summer Convention in Duluth, Minn., July 16–18.

Papers presented before eight technical divisions during the three-day meeting covered a wide range of subjects of local and national interest. On Wednesday afternoon July 16, papers were presented before the Construction, Power and Waterways Divisions. Construction in South America and features of the Maine Turnpike and the Garrison Dam Project were discussed at the Construction session.

Meetings of the Construction, Highway, Hydraulics and Waterways Divisions occupied all of Thursday morning. Papers presented before the Construction session discussed the future outlook of the industry, cost control and the new Building Construction Research Advisory Board. Hydraulics, Structural and Sanitary Division meetings completed Thursday's technical presentations.

Members who took advantage of the opportunity to combine technical advancement with a vacation in a popular resort area also heard Minnesota's timber, peat and iron resources and professionalism in engineering discussed at the general and luncheon meetings on Wednesday.

Power Division Paper Warns Against too Much Speed in Concrete Work

A WARNING AGAINST recurrence of the enthusiasm for speed that gripped the country after the first World War was sounded before the Power Division in the only paper presented, which cited the fact that concrete in a turn-of-the-century hydroelectric plant has caused fewer maintenance problems and less expense than structures built in the 1918–1925 period. E. H. Collins, Spokane, Wash., chairman of the Division's Committee on Operation and Maintenance of Hydroelectric Generating Stations, presided.

In his paper, "Maintenance of Concrete in Hydraulic Structures," A. C. Giesecke, hydraulic engineer, Minnesota Light and Power Co., Duluth, pointed to a 1906-built plant as "not only the oldest, but the very best concrete structure on the company's property."

Emphasizing the severe winters the concrete must weather in the Duluth area, Mr. Giesecke asked:

"Was concrete of 1906 an art that was lost at a later date? It looks that way. Fortunately the record of this fine old structure, capable of enduring our severe climate, is available. It shows that great care was taken to use the exact amount of mixing water for each batch of concrete. The design was developed in the laboratory by testing a great number of short unreinforced beams. So certainly the art of building concrete good enough for this climate was available when later the not-so-good work was done."

Mr. Giesecke presented photographs and charts to illustrate his point that the three oldest plants were in the best shape of the company's 12, and the three newest "are the worst—in a class by themselves."

He recalled that the plants with highest restoration charges against them were built during "the days of World War I, or its aftermath, when we indulged in the slogan of 'Concrete for Permanence,' a form of whistling in the dark, perhaps, and when the cry was 'hurry, hurry, build the plant.' "

Mr. Giesecke listed the primary faults committed in construction of the company's plants as "those associated with attempts at low cost" and asserted that "in some cases unwashed bank-run concrete aggregate was used; probably not enough cement was used; and again in the interest of low cost and great speed, chute distribution was used with its implication of excessive water to make the 'soup' flow."

Of the restoration work, about 75 percent of which has been done in the last 20 years, with the remainder expected to be completed in the next five years, Mr. Giesecke said:

"The concrete restoration program is not viewed as a great affliction, as the cost was not overly burdensome and the future period of useful life of these structures lies ahead without implication of its end."

Construction Division Hears Six Interesting Papers at Two Sessions

TWO MEETINGS were conducted by the Construction Division, one on the afternoon of the Convention's opening day and the other the following morning, with Elmer K. Timby, Princeton, N.J., presiding at both. At the first session, papers were by R. N. Bergendoff, Kansas City, Mo., on "Construction Features of the Maine Turnpike"; by Col. W. W. Wanamaker, Ft. Lincoln, N. Dak., on "The Garrison Dam Project"; and by J. J. Collins, New York City, on "Construction in South America." At the second meeting, papers were presented by Forrest W. Parrott, Sioux City, Iowa, president of the Associated General Contractors of America, on "The Future Outlook of the Construction Industry"; by Arnold O. Babb, Washington, D.C., on "Cost Control for Construction Projects"; and by J. C. Stevens, Portland, Ore., Past-President, ASCE, on "The Building Construction Advisory Board."

In his paper, Mr. Bergendoff detailed construction features of the Maine Turnpike, first major toll road to be paid for 100 percent through private financing and with the users paying the entire cost in tolls. Mr. Bergendoff's firm designed the first 44-mile stretch of four-lane dual superhighway, scheduled for completion this fall. This section of the Turnpike will cost $20,000,000, he stated.

"The project is being completed in an unusually short period of time,

having been started in May 1946 and being scheduled for completion November 1, 1947, despite limitation of construction operations during winter months. Major emphasis has been placed on the preparation of a frost-free subgrade, and the design incorporates all the latest standards considered essential in a controlled-access high-speed artery of travel."

The first stretch of the superhighway, Mr. Bergendoff said, extends from Kittery, on the Maine-New Hampshire border, to Portland, with other construction authorized to be undertaken by the Maine Turnpike Authority along the 500 miles between Kittery and Fort Kent in such sections as would be self liquidating. He stressed that the road is being built without federal aid, without any burden on the credit of the state, without any contribution by the state, and without the use of state gasoline tax funds or other state funds.

"The Maine Turnpike will have a dual highway with two lanes, 12 ft wide, in each direction, separated by a median strip 26 ft in width," Mr. Bergendoff said. "The minimum sight distance is 525 ft from a position $4^1/_2$ ft above the roadway to an object 4 in. high on the roadway surface. The project entails 1,360,000 sq yd of paving, two major stream crossings, four minor stream crossings, and 35 grade-separation structures, and is designed to alleviate traffic difficulties and congestion existing on U. S. Highway No. 1.

Mr. Bergendoff's paper is published in this issue of CIVIL ENGINEERING, page 26.

Calling it the "heart and keystone of the entire comprehensive plan" for development of the Missouri River basin, Colonel Wanamaker described the Garrison Dam project.

"No other single project plays a part in so many features of the overall plans, or affects so many square miles of the Missouri River basin, as the Garrison project," Colonel Wanamaker said. He called the project "perhaps the greatest engineering enterprise ever undertaken in the State of North Dakota" and asserted that in addition to capturing the flood waters of the upper Missouri River and regulating them for the benefit of downstream states, "the project also will bring immeasurable wealth to the State of North Dakota." (See article, page 18, May 1947 issue of CIVIL ENGINEERING.

He estimated the cost of the project at $518,000,000 and said the total cost may reach $200,000,000, including complete power installation and contemplated water diversion. He used maps and drawings in describing for the civil engineers the largest single unit in the Missouri River basin plan. When completed, he said, Garrison Dam will be the world's largest rolled-earthfill structure and its reservoir, extending a distance of 200 miles upstream from the dam, will have a storage capacity of 23,000,000 acre-ft.

Emphasizing the multiple-purpose features of the project, Colonel Wanamaker said:

"Operation studies indicate that in normal and in flood years, reservoirs would be drawn down to previously determined flood-control levels by the end of the winter period, so as to capture the early spring and late spring floods, and then release the water for irrigation, navigation, power, stream sanitation and other purposes during the late summer, autumn and winter. During floods, releases could be reduced so as to prevent flood damages downstream."

Colonel Wanamaker also stressed the fact that recognition is being given the concept that the control and utilization of water in arid and semi-arid regions must adhere to the prinple that the "highest use should be for domestic consumption and the growing of crops, and that the use for power and navigation should be secondary."

The enormous multiple-purpose storage provided by the Garrison Dam project, Colonel Wanamaker said, will afford a wide range of manipulation in the interest of irrigation and power and will provide a means alternate, or supplemental, to the Missouri-Souris project for the diversion of water to eastern North Dakota, and a direct source of water supply for the irrigation of lands in proximity to the Garrison reservoir and downstream from the dam.

"The inclusion of a large dependable source of hydroelectric power in the rather small power network of this region," Colonel Wanamaker said, "will encourage industrial development in a state now almost exclusively devoted to agriculture."

Social labor laws of some Latin American countries have gone far beyond those in the United States, bringing the total construction wage level very close to the brackets of American labor, Mr. Collins, who is vice-president and director of foreign work for Raymond Concrete Pile Co., said in his paper, read by J. T. Dowson of the same firm. He pointed out that while basic wages for native labor are lower than in this country, in many instances "a local workman in the course of a year receives about 100 percent increase over the base wage for extras."

He listed the "extras" as follows:

"First, he is paid travel time to and from his home or an assembly plant near his home. In addition, transportation is provided. He receives 15 working days vacation per year. He is paid seven days per week, providing, however, he has worked all of the working days of the week. If, for instance, he misses one working day without excuse then he forfeits his day-of-rest pay. In addition, he is allowed a percentage of the company's profits, an amount not to exceed $16^2/_3$ percent of his total income per year. He is also taken care of for certain periods if he has an illness, and receives an allowance if living quarters are not available for him."

Of the quality of native labor, the paper said:

"Usually we send only key men and depend on the development of various nationals to learn the numerous trades required in construction work. With the proper selection of foreign key men, this procedure works out most successfully. The foreigner must approach his problem with a kindly attitude, patience, and without any show of superiority. With these characteristics, the aptitude of local workmen develops rapidly. In many trades, such as pile driving, concrete work, welding, plastering, structural steel, etc., the local workman readily proves himself and carries on his duties with great pride."

American workmen, too, find advantages in foreign fields, Mr. Dowson said, particularly in yearly salary.

"Those of us who are associated with the building trade," he said, "know that our skilled workmen normally do not work more than 50 percent of the time. With assurance of his yearly salary, less the necessary allowance to his family, two or three years in foreign fields often provide in hand the funds for the education of a child or the payment of a new home."

Buyers' resistance to other commodity and service prices is making itself felt adversely in the nation's second-largest industry and delaying ready-to-go construction projects totaling 10 billion dollars, Mr. Parrott said in his address. He warned that while construction costs may decline gradually to what can be considered new normal levels, they "cannot return to levels prevailing before the war unless the nation suffers an economic catastrophe."

"Waiting for a considerable drop in costs," and "buyers' resistance to the

price of other commodities and services, which has discouraged investment for expanded business facilities" were listed by Mr. Parrott as principal factors contributing to deferment of many construction projects. A detailed account of Mr. Parrott's paper appears on page 43 of this issue.

Construction costs must be reduced to meet conditions under which "contractors allegedly are pricing themselves out of a juicy market, and owners and Government engineers face costs that exceed the economic return of projects, or the willingness of the taxpayer to pay," Mr. Babb stated.

"If the construction industry, as a group, is to have any effect on our economy and is not going to simply sit back and take a gambling competitive position with each other, it must, through cost analysis and control, keep the slope of the construction cost index just a little better than the others. Contractors today are not competing with each other for jobs nearly as much as they are competing for dollars with other industries." Mr. Babb's paper is in this issue of CIVIL ENGINEERING, page 39.

The building industry research program, seeking technological improvements to increase efficiency and lower costs, was detailed by Mr. Stevens.

As chairman of the Construction Industry Advisory Council, made up of representatives of more than 100 professional and trade groups having a major interest in construction, Mr. Stevens has been active in the formation of the new Building Research Advisory Board, the organization of which, Mr. Stevens said, is expected to do much toward offsetting the fact that "the high cost of building has already had a perceptible effect in preventing, or at least postponing, many specific projects."

"Improved methods and materials offer an effective answer to the charge, so often heard these days, that the construction industry is pricing itself out of the market," Mr. Stevens said.

"Whether and to what extent building costs can and will be readjusted through the operation of economic forces are matters of opinion, but no matter whether costs in general go up, come down, or remain at the same level, there can be no quarrel with the basic fact that technological improvements that can be developed to increase building efficiency and lower building costs will help not only those who must build, but also those who would like to build but cannot afford to do so.

"The efficacy of organized research as a means of improving the products of American industry has been demonstrated in too many instances to require further argument. American business no longer regards money spent in the laboratory as a gamble; it is now considered an investment. Mr. Stevens' paper appears in this issue of CIVIL ENGINEERING, page 36.

Three Corps of Engineer Officers Present Papers at Two Waterways Sessions

FOUR PAPERS, three of them by colonels in the Corps of Engineers, were presented at two sessions of the Waterways Division. Max C. Tyler, Vicksburg, of the Division's Executive Committee, presided at both.

Authors on the program were: M. W. Torkelson, director of regional planning, State Planning Board, Madison, Wis., who spoke on "The Wisconsin-Fox Rivers Diversion Plan"; Col. Dabney O. Elliott, Division Engineer, Great Lakes Division, Chicago, who presented a paper, "Part Played by the Great Lakes Transportation System in World War II" (read by Wendel E. Johnson, U.S. Engineer Office, Omaha, Nebr.); Col. Delbert B. Freeman, District Engineer, Omaha, whose paper titled "Developments of the Missouri River Basin," was read by Mr. Johnson; and Col. H. H. Cole, District Engineer, Duluth, who read a paper, "Duluth-Superior Harbor."

Diversion of water from one river to another, controlled to be effective when most needed, was described as a measure which would "work like a blood transfusion into the circulatory system of an ailing human being" by Mr. Torkelson, a member of the Society's Committee on Diversions, which has been studying this subject. He discussed the proposal under consideration in his state to divert 1,500 cfs for 120 days each year from the Wisconsin River to the Fox River which, he said, "would inject new energy into the power system of the lower Fox," where "the water would serve to drive the already-installed wheels of existing plants located in populous areas which need the water badly." Sanitation benefits also were cited as potential results of such a diversion, which would resolve the difficulty of "a highly unsanitary condition" at times of low flow.

Such a project, Mr. Torkelson pointed out, would amount to diverting water in a reverse direction from that of the project, whereby 1,500 cfs is diverted the year-round from Lake Michigan into the Mississippi River by way of the Chicago Drainage Canal and the Illinois River. The Wisconsin-Fox Rivers project, he said, would divert water from the Wisconsin River, a tributary of the Mississippi, into Lake Michigan and results in a replacement of about one-third of the Lake Michigan-Mississippi River diversion loss.

Conservation of water as a natural resource—a project only recently launched by the engineering profession at the instigation of the ASCE—was urged by Mr. Torkelson. World War II, he said, developed important facts regarding need for conservation of natural resources, but principal recognition has been achieved for conserving mineral resources.

"Another great natural resource, which has been generally accepted in the past as being limitless like the air and the sunlight, is the water resource," Mr. Torkelson said. "However, with the terrific demands for water by heavy industrial development, it is becoming increasingly evident that there is a limit to this, also. Our great concentrations of population are beginning to encounter increasing difficulty in securing adequate supplies of water of acceptable quality. We have been conscious, but only slightly so, of the fact that the suitability for human habitation of those parts of the earth where the climate permits, depends very largely on the amount of water of acceptable quality that is available. Still more have we failed to realize fully the extent to which improvements in the standard of living already have increased the use of water, and how much water is required to maintain that high standard in populous areas."

Mr. Torkelson cited the Wisconsin paper-manufacturing industry as an example, declaring: "To make a ton of paper requires 25,000 gal of water, more than 100 tons, to use round figures. A single paper mill in the vicinity of Appleton, and it by no means the largest, uses ten times as much water as the city, which has a population of more than 30,000, and this water must be suitable as to quality and dependable as to amount."

He also asserted that availability of water was one of the most important

factors, "if not the decisive factor," in the location of most of the war plants constructed for World War II.

So "brilliant, vital, spectacular, and essential" a World War II role did the Great Lakes transportation system play that its interruption would have had an "immediate and disastrous" effect on the national effort, Colonel Elliott asserted in his paper. He added that if the $325,000,000 federal cost of Great Lakes navigation works in the last 100 years were all charged off against the tonnage moved during the recent war, it would have amounted to only about 40 cents per ton.

Calling "production and transportation of materials and finished products a fundamental upon which rests the successful prosecution of modern war," Colonel Elliott emphasized that, "the channel of a water route will accept a sudden and violent increase in traffic with far less need for new construction and increased maintenance than a land route." He asserted that the expansion of lake commerce which preceded the war was an important factor in the ability of the Great Lakes transportation system to accept the inordinately heavy traffic brought on by the war.

"In the five-year period, 1932–1936, average annual total net tonnage handled by the Great Lakes transportation system was 92,482,000; for the next five-year period, the tonnage was 155,588,000; and for the war years, 1942–1945, 206,969,000. These figures indicate that the average annual total tonnage, as reckoned by five-year periods, increased about 68 percent during the decade prior to the war and that the average annual war tonnage showed an increase of about 33 percent of that of the preceding five-year period."

Colonel Elliott detailed some construction and alteration works entailed by the war, and concluded:

"The beginning of hostilities found Great Lakes navigation prepared to execute the vital war measure with noteworthy success. Shipping was available for initial requirements and the shipbuilding facilities were available to the needed additional tonnage. The lake fleet built up during the prewar years was further augmented by a total of 26 freighters built in Great Lakes shipyards and commissioned under U.S. Registry. Five of these vessels were 640 ft in length and were commissioned in 1942. The remaining 16 were 621 ft in length and were commissioned in 1943. These last were intended to replace 29 smaller overage freighters. However, under the stress of the war emergency, these 29 vessels were retained in service until no longer needed."

Evolution of Duluth-Superior Harbor—from a port from which furladen canoes were paddled by Indians to the nation's second-largest tonnage port through which more than 54 million tons of commerce passed last year—was detailed by Colonel Cole. He paid tribute to the engineering ingenuity which brought savings to Americans of some $26,000,000 in coal shipping costs alone in a single year on a total federal government investment of $10,915,400.13 in permanent work and maintenance to June 30, 1946.

Duluth-Superior Harbor consistently ranks second only to New York Harbor as the largest port in the nation in point of tonnage, and is probably the most important bulk traffic port in the world in spite of the fact that it enjoys a navigation season of only eight months, Colonel Cole asserted in tracing the history of the Lake Superior port through which flows more than half of all the iron ore shipped from Great Lakes ports.

In 1945, which Colonel Cole cited as an example, the Duluth-Superior port tonnage was 65½ million, compared with New York Harbor's 104 million tons. But, he pointed out, the third ranking port, Philadelphia, moved only 37 million tons that year.

In his talk, in which he traced the history of the port from the days when loading was done by wheelbarrow to the present, when equipment is available for loading iron ore at the rate of 25,378 tons per hour and grain at the rate of 140,000 bushels per hour, Colonel Cole presented some early-day sidelights. Among them were:

A map made from a survey of the harbor, made in 1861 by Capt. George B. Meade, of the Corps of Engineers, prior to the time he was called into the Union Army, where he attained fame as the winning general at Gettysburg.

A story of legendary proportions regarding early-day litigation by which Superior citizens sought to enjoin Duluthians from constructing a canal connecting Lake Superior with Superior Bay.

"The six-month old city of Duluth let a contract for dredging in the fall of 1870 for a canal 150 ft wide and 16 ft deep, protected by piers on each side, extending into 18 ft of water in the lake," Colonel Cole said. "A dredging company was put on the job and the work was pushed with all possible speed, and when winter put a stop to operations, it had dredged through about two-thirds of the peninsula. The story goes that on Saturday afternoon several Duluthians received word of the issuance of the Superior-sought injunction by the Federal Court in St. Paul. Early Sunday morning, about 50 sturdy and determined Duluthians went to work with pick and shovel and wheelbarrow to cut through the narrow neck of land remaining. By noon the water began to trickle through, only a tiny stream at first, but as the water in the bay at that time was about 6 in. higher than the lake, the powerful current widened the channel and by mid-afternoon that Sunday a rowboat was able to pass through to the lake. By the time the injunction could be served on Monday the opening was about 30 ft wide and small craft were passing through it."

Four Papers Cover Wide Range of Subjects Before Highway Division

FOUR PAPERS covering a wide range of subjects were presented at the Highway Division meeting, over which Charles M. Upham, Washington, D.C., chairman of the Division's executive committee, presided. Papers presented were: "Program and Progress of Three-Year Plan of Highway Construction in the Northwest Area," by S. L. Taylor, U.S. Public Roads Administration, St. Paul; "Alaska Permafrost Investigation," by H. J. Manger, U.S. Engineer Office, St. Paul; "Soil Stabilization for Highways in Northern Minnesota," by George W. Deibler, highway engineer, St. Louis County, Duluth; and "The Dynamics of Highway Bridges," by Prof. J. A. Wise, University of Minnesota Civil Engineering Department.

Mr. Taylor discussed the postwar highway program in the Northwest—Minnesota, Wisconsin, and North and South Dakota—and indicated that conditions in this area are representative of virtually the entire country.

The dollar amount of work under contract, Mr. Taylor said, "might be considered a favorable volume of work by prewar standards; however, it is not more than one-half of the first

year's apportionment of federal funds under the 1944 Act." He pointed out that in addition to increased prices—the index for structures was cited at 188.1 in the first quarter of 1947 as against 87.7 in 1940—there are other deterrents: scarcity of materials and of labor, lowered efficiency of labor, and the limited supply of equipment available.

Mr. Taylor described such a shortage in engineers that the state highway departments were compelled, in some instances, to furnish the services of engineers to counties in order to provide for improvement of roads.

"The engineering personnel continues to be very limited owing to shortage in numbers and the competition of private industry, which is able to pay much higher salaries," he said. "Unless public work is made more attractive, at least from an economic standpoint, I fear that engineering personnel will continue to be a problem."

The development of the urban program has not kept pace with the federal-aid program, Mr. Taylor said, pointing out that the purpose of the urban funds was to relieve the congestion on roads leading into larger urban centers "and not just to make minor improvements, or what are sometimes called routine 'housekeeping' projects.

"There has been developed through the years a gridiron system of streets, a design wholly unfitted to modern traffic movement, yet one with which the citizens are familiar. On this gridiron the city engineering forces have devoted most of their efforts to date and major improvements cutting through the present system are necessarily exceedingly expensive and generally resisted on this account."

Calling for "some bold planning if we are to open up these entrances into the larger cities to permit greater freedom of movement with reduced travel time and greater safety," Mr. Taylor lauded the work of interim legislative committees which, he said, "together with a public well informed of the problems with which we are all faced in providing for the growing traffic needs of the nation, should be of great aid in supplying the needed tools to provide for safe free flow of traffic over our highways."

Mr. Taylor pointed out that funds provided by the 1944 Highway Act did not become available to the states until October, 1945, and that the funds are available for obligation not to exceed one year after the year for which they are apportioned.

"There is, however, a bill now pending which will make the funds available for a maximum of two years after the year for which they were apportioned, and in effect will extend our three-year program over a period of five years," Mr. Taylor asserted. "This seems desirable because of the difficulties encountered in carrying on this vast program."

Progress in the Army Engineers' battle to conquer Permafrost—a phrase coined to describe permanently frozen ground—and to develop design criteria and methods adaptable to far northern construction of airports, roads, underground utilities, buildings and other types of structures was reported by Mr. Manger.

Describing Permafrost as a thickness of soil or other deposits at a variable depth below the surface of the earth in which a temperature below freezing has existed continuously for a long period of time, Mr. Manger reported:

"This phenomenon is quite extensive and covers about one-fifth of all the land area in the world. In the northern hemisphere, Permafrost exists in about 80 percent of Alaska, 50 percent of Canada, and practically all of Siberia. Its origin is unknown, but it is believed that the phenomenon was formed during the ice age."

Only the Russians, Mr. Manger said, gave much thought to the effect of Permafrost on construction prior to World War II, and in the recently undertaken studies by the U.S. Engineers, much has been gained through the study of Russian literature on the subject.

Construction difficulties arise, Mr. Manger said, when the vegetation, which is a natural insulator, is removed and the ground thaws rapidly. In many cases quagmires result, in which the construction equipment becomes mired and it is necessary to overcome these obstacles by controlling the thawing action by backfilling the excavated area immediately with sand and gravel to a sufficient depth to prevent further lowering of the Permafrost table.

Assigned by the Chief of Engineers to the St. Paul District, Corps of Engineers, in January, 1945, the investigation is in progress under the direction and supervision of Col. Walter K. Wilson, Jr., District Engineer at St. Paul, with assistance being rendered by the University of Minnesota and Purdue University, among various institutions and individuals participating.

After describing some of the ground operations under way in the study, Mr. Manger revealed that aerial photography bids fair to be so successfully beneficial in the work that it "may eventually repay the entire expense" of the whole Permafrost investigation.

"The Government has a contract with Purdue University to determine the feasibility of using air photos in identifying Permafrost areas on the ground," Mr. Manger said. "By a study of air photos, correlated with extensive field trips in the same areas, it has been possible, from existing air photos of surface details such as drainage, topography, types of vegetation, and tree growth, to select areas where construction can be successfully carried out, as well as those areas which should be avoided at all cost. It has been found that the air photo method can eliminate long and extensive ground explorations by selecting the most suitable site in a large area, and that ground explorations can then confirm the detailed location."

Emphasizing that it will require several years of observation in various locations and a variety of conditions to determine thermal characteristics of Permafrost areas and to develop design criteria and construction methods as a guide to construction engineers, Mr. Manger cited the following as "trends which engineers would do well to consider" in new construction in Permafrost regions:

"Site selection is very important and wherever possible structures should be located on areas of coarse-grained materials where the lowering of the Permafrost table will not cause settlement of the structures.

"In areas where there is danger of settlement by the lowering of the Permafrost table, an air space should be provided under heated buildings to prevent heat transfer into the ground.

"In the construction of roads and runways, all fine-grained material in the subgrade subject to frost action should be removed at least through the frost zone and be replaced by coarse-grained materials.

"Where piling is used under structures, the piling should be placed at least twice the depth of the frost zone into Permafrost to prevent uplift by frost action in the active layer.

"By thorough knowledge of the soil characteristics and the extent of Permafrost it is possible through proper construction methods to avoid settlement or ultimate failure of structures."

Highway bases for year-round roads, ingredients of which are as meticulously mixed as a prescription concocted by a druggist, were described by Mr. Deibler. In fact, he

said, chemicals actually are added periodically to the other ingredients in efforts to obtain uniform high density of sufficient bearing capacity to withstand anticipated loads, without material displacement under all weather conditions.

"Good results are being and will be accomplished," Mr. Deibler said, "by the selection of aggregate material of proper gradation, including binder soil, control of moisture content, and combination of aggregates with calcium or sodium chloride."

After describing the aggregate selection process under which stipulated percentages of the materials must pass through various-sized sieves, Mr. Deibler said:

"Unless the base is to be followed almost immediately by a surface course, a treatment of 1 lb per sq yd of calcium chloride is applied, usually after the road has been given the initial compaction. Additional surface application of $\frac{1}{4}$ lb per sq yd is applied at least twice during the summer season, about June 15 and August 15."

Economic advisability of such careful preparation of road bases, including the addition of the chemicals to absorb moisture and to aid the adhering process among the other ingredients, was stressed by Mr. Deibler. Particularly in areas where extremely cold winters prevail, causing load restrictions to be placed on highways during the spring break-up, will better-prepared road bases be justified, he said.

"These restrictions, for a period of 30 to 60 days, hold gross loads to 4 to 6 tons and even 3- to 4-ton axle loads," Mr. Deibler asserted, "and are so severe that they definitely retard essential transportation operations. If stabilized roads will relieve this situation, and they apparently will to a large extent, the additional cost can be well justified on this one item alone. In order to accomplish satisfactory stabilization, three fundamental factors—gradation, water content and compaction—must be controlled in their relationship with each other, both independently and combined."

Other economic factors were cited by Mr. Deibler in justification of the additional costs involved in the extreme care used in effecting base stabilization:

"Local communities and rural residents are demanding all-weather and all-year roads. Gravel roads, and even bituminous surfaced roads in some instances, that appear to be well constructed and can be well maintained during a large part of the year, are found impassable during the spring break-up. In some cases, this causes entire communities to be isolated from outside service for many days. In our modern rural society, this becomes a serious matter. Large consolidated schools served by bus transportation are forced to close; mail routes are closed; creamery, dairy and other vital food products are unable to get to market, and likewise processed food for rural consumption cannot be delivered. Then too, many sections of the country now are promoting the tourist industry, which in the final analysis always involves the use of local county roads."

State Influence on Design of Multi-Purpose Projects Discussed Before Hydraulics Division

FUTURE MULTIPLE-PURPOSE waterway development projects will face more complications from the standpoint of design and operation than existing projects, Don McBride, secretary-manager of the National Reclamation Association, warned in a paper read by C. N. Philips, New York, at the Hydraulics Division Session. Therefore, it was emphasized, such projects must be scrutinized carefully to produce sound, economic and beneficial use.

In the paper entitled "Influence of State Governments on Design of Federal Multiple-Purpose Projects," it was pointed out that federal and state engineers approach such undertakings from different view points. "For example, it seems to me that the federal engineer and the state engineer stand side by side on the bank of the river and the federal engineer looks upstream to determine the maximum amount of the watershed that can possibly be controlled, while the state engineer looks downstream to determine the maximum amount of the land that can be protected or developed."

The paper listed principles considered basic from the state engineer's standpoint. "If a project is to be repaid by its earnings, naturally it is necessary to practice most stringent economy. On the other hand, if the project is non-reimbursable the designing engineer may over-design. Such matters as spillway designs, elimination of agricultural production by the inundation in reservoir areas as compared to the production below the reservoir and the effect on local subdivisions of government are some of the problems that affect the state engineer's viewpoint."

The manner in which states process reports of federal departments reporting proposed projects was criticized in the paper. Many states, because of lack of funds and personnel, are not in a position for thorough investigation of their reports on federal projects. In other cases, the states are so thorough in their studies that the net result is two separate reports on the same subject going before Congress, he said.

The paper was one of five presented at the Hydraulics Division sessions, presided over by Lorenz G. Straub, director of the St. Anthony Falls Hydraulic Laboratory at the University of Minnesota and member of the Division's executive committee.

"The Entrainment of Air in Open-Channel Flow" was discussed in a paper prepared jointly by Dr. Straub and Warren W. De Lapp, assistant professor of hydraulics at the St. Anthony Falls Laboratory. Professor De Lapp made the oral presentation.

For slopes above 32 deg, entrainment of air increases the mean velocity of the flow, making it necessary to take effects of aeration into account for accurate results, Dr. Straub and Professor De Lapp concluded on the basis of experiments with high-velocity flow. For smaller slopes the increase in the value of Manning's n is largely balanced by the increase in the hydraulic radius resulting from aeration. Their research was originally proposed ten years ago by the ASCE Committee on Hydraulic Research and sponsored by the Engineering Foundation. Included were tests over a wide range of discharges and slopes for each of three types of channel roughness, a painted steel surface, a sand-coated one and a surface obtained by lining the channel with two layers of expended steel mesh.

On a steep enough slope water becomes white in appearance owing to the presence of air, and the bulk volume of the flow is substantially increased. Conditions under which the entrainment of air occurs and its effects on flow characteristics such as velocities and depths are important to the designing engineer. But the designing engineer has been forced

to rely largely on empirical formulas developed for low velocities, the extrapolation of data from smaller structures and his own judgment, they pointed out.

In the Minnesota experiments the amount of air entrained in the flow at any point was determined by drawing off a sample of the mixture with equipment especially designed for that purpose. They found virtually all the air near the free surface at the lowest slope, with the distribution becoming more nearly uniform as the slope of the channel was increased.

"Comparing results at similar slopes for the three types of surface roughness," the report said, "the latter is seen to have a small effect on the amount of entrained air but a considerable effect on the depth of flow. On the other hand, there is seen to be a relatively small variation in the depth of flow for each surface, in spite of the fact that the channel slope varies from 8 to 44 deg. Apparently the increase in depth due to the entrainment of air is approximately balanced by the increase in velocity due to the steeper slope.

"The fact [that the experimental data may be represented by an equation of the logarithmic type] indicates that the air is distributed throughout the flow by turbulent diffusion and establishes conclusively the existence of a close analogy between the entrainment of air and the transportation of suspended sediment. In other words, the turbulence in the flow overcomes the buoyancy of the air bubbles in preventing their escape in the same manner as it overcomes the weight of sediment particles in preventing their deposition."

The experimenters found that the rate of discharge, and thus the hydraulic radius and velocity, had a relatively small effect on the amount of entrained air. The amount of air was found to vary with different slopes and roughnesses, but to remain essentially constant for any particular slope. The reason for this, they concluded, appears to be the fact that all flows at a particular slope are geometrically similar as regards entrained air, regardless of the absolute depth of flow.

Hunter Rouse, director of the Iowa Institute of Hydraulic Research at the State University of Iowa, discussed "Diffusion of Submerged Jets" in a paper illustrated by slides and motion pictures.

"As the direct result of turbulence generated at the borders of a submerged jet, the fluid within the jet will undergo both lateral diffusion and deceleration, and at the same time fluid from the surrounding region will be brought into motion," he reported. "The approximate characteristics of the corresponding mean-flow pattern are derived analytically, with the exception of a single experimental constant, through assumptions that: (1) The velocity distribution at any cross section follows the error law within the zone of diffusion; (2) the diffusion zone expands at a linear rate which is independent of the efflux velocity; and (3) the pressure is hydrostatically distributed at all points." Dr. Rouse presented experimental data verifying the assumptions with good approximation and providing the necessary coefficients for flow from both slots and orifices.

J. B. Thomas, president of the Texas Electric Service Co., Fort Worth, Tex., gave a paper on "Coordination of Operation of Multiple-Purpose Reservoirs with Public Utility Systems." "An Engineering Concept of Flow in Pipes" was outlined by Charles W. Harris, professor of civil engineering at the University of Washington, Seattle, Wash.

Sanitary Engineering Division Hears Three Papers on Minnesota Problems

THREE PAPERS on Minnesota sewage and water treatment problems were heard by the Sanitary Engineering Division at its session. Professor George J. Schroepfer, University of Minnesota, Minneapolis, 1946 chairman of the Division's executive committee, presided. Papers were presented by Harvey G. Rogers, Minneapolis, director, division of water pollution control, Minnesota State Department of Health; A. J. Duvall, St. Paul consulting engineer, and M. D. Lubratovich, assistant manager, water, gas and sewage disposal department, Duluth.

A $15,000,000 program for new construction and additions and improvements to sewage and industrial waste disposal facilities in Minnesota is in the making to alleviate "unsatisfactory conditions," Mr. Rogers stated in his paper. He estimated that the cost of projects for which plans have been approved in the state's postwar pollution abatement movement would be $4,778,000; that work for which plans are in the process of preparation will amount to another $5,554,000, and that the cost of projects for which engineering studies and reports have been completed or are authorized, including 18 systems with treatment and 15 new plants, would be $2,890,000. Already approved by the State Board of Health, he said, are projects totalling $815,000 for a total of the four foregoing items of $14,037,000.

"It is estimated," Mr. Rogers said, "That the above construction program, together with work which is being planned for waste control at major industrial plants, will exceed $15,000,000."

In his paper, "Water Pollution Control in Minnesota," Mr. Rogers traced the history of that control in Minnesota from the passage of the state's first legislation on the subject in 1887 through the 1945 Water Pollution Control Act now in force, under which the State Commissioners of Conservation and Agriculture, the Secretary of the State Livestock Sanitary Board, one member appointed at large by the Governor, and the Secretary of the State Board of Health act as a State Water Pollution Control Commission.

"There are 759 municipalities with 500 water supplies," Mr. Rogers said. "Only 20 of these supplies are from surface water, although they serve approximately 1,000,000 of the 1,600,000 total. There are 332 municipalities with sewer systems and there are 202 sewage treatment plants serving 209 municipalities where some type of treatment is provided.

"Much of the program which has been accomplished can be accredited to municipal officials and to the activities of civic and conservation groups in drawing public attention to the problem and promoting local projects. Although pollution has been reduced in many lakes and streams, there are unsatisfactory conditions to be found at many places and there is still much to be done before pollution from sewage and industrial wastes is sufficiently reduced to achieve the standards of stream cleanliness expected by the people of the state."

Surveys conducted and other work performed by his firm in connection with a proposed sewage treatment plant for Rochester, Minn., were discussed by Mr. Duvall.

Mr. Lubratovich's paper was titled, "The Water Supply of the City of Duluth."

Use of Wood and Aluminum as Structural Materials Discussed by Division

USE OF WOOD and aluminum alloys as structural materials was discussed in two papers read at the Structural Division meeting, over which Craig P. Hazelet, Louisville, Ky., member of the Division's executive committee, presided. L. J. Markwardt, assistant director of the U.S. Department of Agriculture's Forest Products Laboratory at Madison, Wis., and B. J. Fletcher, chief engineer, development division, Aluminum Co. of America, New Kensington, Pa., were authors of the papers on wood and aluminum alloys, respectively.

Postwar use of wood, fostered by wartime metals shortages, is progressing so rapidly—notably one called "sandwich construction" and used in aircraft and railway cars—that America's engineers are finding a challenge in the study of use of forest products as a structural material, Mr. Markwardt said.

Recent research, he asserted, has so advanced the use of wood as a diversified building material that "engineers have found it difficult to keep abreast of current data." He added that there are many evidences of lack of basic knowledge of wood, of its mechanical properties and of structural design procedures, and said that engineers must meet the challenge presented by the fact that "many technical schools have not kept their courses up to date or have omitted consideration of wood entirely."

Mr. Markwardt divided the timber industry's history into three distinct periods—the "land-clearing" period, when the cutting of timber was done primarily to make way for agriculture; the "timber mining" period, when the forests were considered so abundant that timber was cut "without thought of replacement"; and the present "timber crop" era, in which the concept of this resource is that it must be replaced by systematic reforestation.

Statistically, Mr. Markwardt demonstrated that, despite the tremendous increase in use of steel and other metals in the twentieth century, the per capita lumber production in 1947 is estimated to be approximately as high as it was nearly a century ago. In presenting his data on the rise and fall of per capita lumber production, Mr. Markwardt showed that it rose from 216 board ft in 1850 to an all-time high of 480 board ft in 1910, dropped to an all-time low of 212 in 1930, but now has risen to 240, about where it was 90 years ago.

Mr. Markwardt described new construction developments involving the use of wood, such as laminated wood arches in hangars, permitting a clear span of 150 ft, and cited experiments that have been made to improve the quality of wood by treatment with various chemicals.

An innovation in the use of wood traceable directly to World War II is the "sandwich construction" pioneered by the British in the building of Mosquito bombers, Mr. Markwardt revealed.

"Sandwich construction," he said, "consisting of plywood faces glued to balsa cores, was employed in the wings and fuselages of these bombers, where light weight and strength were essential. Progress in the use of this type of construction is taking place rapidly, with applications ranging from aircraft to railway cars."

Mr. Markwardt pointed out that the American Society for Testing Materials, in recognition of the importance of sandwich-type construction, called a conference a year ago of all those interested in the subject and has appointed a special committee to help provide design criteria for American structural engineers.

In his paper, Mr. Fletcher cited examples to show how steel and aluminum each has its place in the structural field, depending on weight and strength desired, and told of increased use being made of aluminum in various kinds of structures.

Peat Can Become Money-Saving Industrial Fuel, Fitzgerald Tells Luncheon Session

DEVELOPMENT OF PEAT as an industrial fuel offers a challenge to the best talents in the engineering profession and is of first importance to national security, Robert L. Fitzgerald, vice-president and general manager of the Duluth Steam Corp., told ASCE Members and guests attending the Thursday luncheon at the Duluth Summer Meeting. Russia already is processing from 50 to 60 million tons of bog peat into gas and power for industrial needs.

"Some important facts about [the Soviet] use of peat seem to be reliably established," said Mr. Fitzgerald, listing the following:

"They have eliminated the inherently high peat transportation costs by converting the peat into electric power and fuel gas at the site of the bog and transmitting the end products to the points of consumption.

"They have reduced production man-hours from 75 to 80 percent by introducing hydraulic and mechanical material-handling methods.

"They are operating power stations up to 200,000-kw capacity exclusively on peat fuel.

"They are continuing to expand the use of peat as fuel in large power-generating stations.

"They consider their peat bogs as large reservoirs of a wide variety of chemical products, and they keep a staff of 300 research scientists studying methods for recovering the chemicals on a commercial scale."

Half of the United States's peat deposits are in northern Minnesota near the iron ranges. Use of this local fuel in the iron-mining operation, to produce a high metallic content shipping product and in delivery to the mills would make important savings in the war-burdened lake shipping, rail transportation and coal supply, Mr. Fitzgerald pointed out.

Discussing plans for utilization of low-grade, hard rock iron ores and beneficiating the natural ore to a concentrated product, the speaker reported that the 1,250,000 tons of coal required for producing up to 10,000,000 tons of concentrated ore a year would cost $8,750,000. If methods can be developed for mining and drying peat at a unit cost of about $2 a ton, then the total cost of peat fuel to operate this project for a year becomes $4,000,000 representing a potential saving or profit on one project of $4,750,000 a year.

Experiments on forming 85 percent moisture peat into pellets whose size can be controlled "can easily prove to be the answer to the local metallurgical use of this abundant supply of local, low-grade fuel," Mr. Fitzgerald said. Additional experi-

(*Continued on page 80*)

New Orleans Plan Includes Union Passenger Terminal

ISSUANCE OF $23,500,000 worth of general obligation bonds of the City of New Orleans, recently approved by the taxpayers at a special election, will provide $12,000,000 for railroad grade-crossing elimination and terminal improvement, $10,500,000 for paving of streets and $1,000,000 for acquisition of land for a proposed civic center.

Through the New Orleans Railroad Terminal Board, the city has been negotiating for a number of years with the railroads entering New Orleans for a new union passenger terminal, the abandonment of various railroad facilities, relocation of yards, and a comprehensive grade-crossing elimination program. To assist in this program, in 1938 a constitutional amendment was passed authorizing the city to issue revenue bonds to build and own the passenger terminal.

Under terms of the city's agreement with the railroads the latter will operate the terminal, guaranteeing payment of adequate rental to the city to pay the principal and interest of the revenue bonds. These bonds are not an obligation of the taxpayers. After the bonds are paid off, the city will receive from the railroads an annual rental in lieu of taxes. Part of the $12,000,000 bond issue just authorized will go to pay the city's share of the cost of grade-crossing elimination under this program.

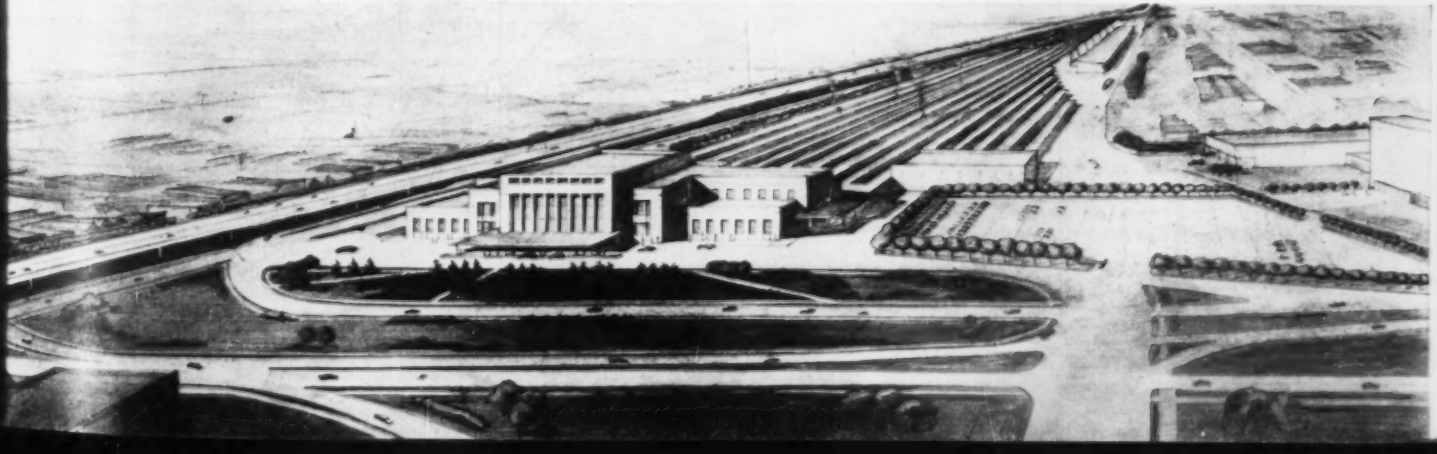
Construction of 28 grade separations is planned, together with numerous street improvements. The program is coordinated with an arterial highway plan study made by Robert Moses for the Louisiana State Highway Department about a year ago. As part of the program, the 115-year-old New Basin Canal (for navigation) through the heart of the city will be closed and filled. The city expects to complete its negotiations with the railroads by the end of this year and to commence the first phases of the program early next year. The entire railroad program, which will be under the direction of the New Orleans Railroad Terminal Board, will require about five years to consummate. The firm of Godat and Heft of New Orleans, La., are consulting engineers for the Terminal Board.

The $10,500,000 for paving represents the first major paving bonds issued by the city in about 20 years, and will be expended for a program of major street improvements, based on the major street program of the City Planning Commission. Some portions may also be used to improve secondary streets.

The $1,000,000 for the civic center is to be used for the acquisition of approximately six squares of present slum area on which, together with several squares now owned by the city, New Orleans proposes to develop ultimately a center for city and state governmental functions.

TWENTY-EIGHT GRADE SEPARATIONS, together with Union Terminal and numerous street improvements incidental to railroad project, will reduce congestion and speed traffic in New Orleans. Overpass shown at right is part of terminal improvement and grade crossing elimination program that also will include abandonment of various railroad facilities and relocation of yards.

PROPOSED UNION PASSENGER TERMINAL is part of extensive New Orleans traffic and civic improvement program slated for next five years. Designs are coordinated with arterial highway plan study made by New York Park Commissioner Robert Moses last year. Report criticizes confusion and disorder created by many converging railroads and states that five passenger stations scattered across downtown area of city result in practically no through car or mail service. About 31 passenger trains and 52 freight trains that pass each way daily are inconvenience and delay to vehicular traffic.



CONSISTENT IN DESIGN, all underpasses on 44-mile section of Maine Turnpike resemble Moody Road Underpass pictured here under construction. Structures consist of rolled-beam spans with concrete floors supported on concrete abutments and center piers. Use of absorptive lining of forms on all exposed surfaces eliminates form marks.

Privately Financed Superhighway in Maine Incorporates Latest Design Features

Planning, Financing and Construction of $20,000,000 Toll Road Takes But 21 Months

R. N. BERGENDOFF, M. ASCE

Howard, Needles, Tammen & Bergendoff, Consulting Engineers, Kansas City, Mo.—New York, N.Y.

A 44-MILE CONTROLLED ACCESS superhighway, first section of the Maine Turnpike recently authorized by the state legislature through an enabling act creating the Maine Turnpike Authority, is scheduled for completion in November of this year. The enabling act provides authorization for a toll road from the southern boundary of Maine at Kittery to the northern boundary at Fort Kent, a distance of some 450 miles. In addition to the 44-mile southern section of the Turnpike now being built—from Kittery to Portland—additional sections are under consideration. Since the enabling act does not permit general obligation bonds, amortization can be made only through revenue from toll, making it possible to sell bonds only for construction of sections where traffic justifies it.

CONSTRUCTION OPERATIONS are well under way on a $20,000,000 section of the projected Maine Turnpike, the first major toll road to be 100 percent privately financed, with the user to pay for the cost. The 44-mile superhighway—one of the nation's major postwar highway projects—incorporates all the latest standards considered essential in a controlled access high-speed artery of travel. Major emphasis has been placed on preparation of a frost-free subgrade.

Scheduled to receive traffic November 1, 1947, the project is being completed in the unusually short period of 21 months even though construction operations were limited during the winter of 1946–47. Financing, preparation of plans and specifications, advertising for bids, awarding of contracts and all construction operations will be carried out in the 21-month period. Financing of the project through sale of revenue bonds was completed in February 1946, and construction work began in May. Bonds carry

MUCK ON RIGHT-OF-WAY—generally less than 24 in. in depth and confined to areas adjacent to water courses—is excavated, wasted and replaced with A-3 embankment material. Soil types on basis of location along highway are rock 27 percent, sand 23 percent, clay 36 percent, and muck 14 percent.

an exceptionally low interest rate—2 1/2 and 2 3/4 percent.

The dual highway will have two lanes 21 ft wide in each direction, separated by a median strip 26 ft in width. The maximum gradient is 4 percent and the maximum curvature 1 deg. Minimum sight distance is 525 ft from a position 4.5 ft above the roadway to an object 4 in. high on the roadway surface. Each 24-ft roadway will have a 4-ft paved shoulder adjacent to the median strip and an 8-ft paved shoulder along the outer side (see Fig. 1).

Drainage of the median strip and inside half of each roadway is to gutters on each side of the median strip at the inside edge of the 4-ft paved shoulder. The water is collected in catch basins at about 500-ft centers and then carried through 12-in. culvert pipe of precast concrete to the outside of embankments. Catch basins were poured in place.

The spacing of the dual roadways and the width of the median strip are maintained throughout the length of the highway, with twin structures provided for the Turnpike at all stream crossings and grade separations. Traffic interchanges are located at Wells, Saco and Beddeford, with access limited to these three points in the 44-mile length. A fourth interchange at Kennebunk is under construction.

The project includes 1,360,000 sq yd of paving, two major stream crossings, four minor stream crossings and thirty-five grade separation structures. The alignment is entirely new and a right-of-way in general 300 ft in width has been acquired. Three fourths of the new right-of-way is through timbered land.

Clearing of the right-of-way was limited to about 140 ft in width. The balance of the 300-ft strip was left undisturbed, permitting the present growth of shrubs, evergreens and other native trees to enhance the natural appearance of the road and wayside. This intervening growth also will tend to discourage erection of unsightly advertising signs outside of right-of-way lines. Clearing was classified as light, medium or heavy. Light clearing was generally confined to stripping operations by bulldozers in open fields. Medium clearing included brush and small trees cut by crews employing the usual cutting tools, brush hooks and axes. Heavy clearing consisted of large trees 30 in. in maximum diameter cut by hand tools and power chain saws. Usable timber was cut up and hauled away, with brush and remaining material piled and burned.

EMBANKMENT OF A-3 MATERIAL (above) is placed on right-of-way of dual, controlled-access highway. Most of sand found in roadway subsurface is suitable for embankments, but only occasionally is good gravel found within right-of-way. Approximately 96 percent of roadway excavation is salvaged for fill.

ROCK IS EXCAVATED (above) by drilling holes 5 ft on centers and shooting 150-175 holes at a time. Grading operations include removal of 263,000 cu yd of rock with maximum of 4,780 cu yd in one station length.

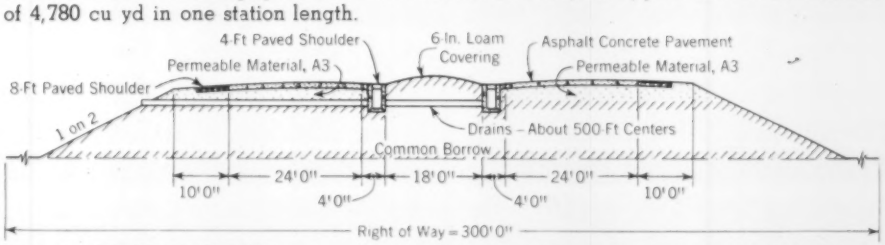


FIG. 1. SECTION SHOWS principal dimensions and construction details of dual highway. Drainage of median strip and inside half of each roadway is to gutters from which water is collected at about 500-ft centers and carried outside of embankments.

ALL ROCK REMOVED from right-of-way of Maine highway is placed in embankments, with common borrow added to fill voids. Maximum haul of rock is about 2,500 ft, average is 1,000 ft.

Three to six crews averaging 20 to 40 men in each crew were employed in the clearing operations.

Grubbing was accomplished by bulldozers and by excavating with buckets, with stumps and roots burned or loaded on trucks by cranes to be hauled off to stump dumps. These dumps were areas adjacent to but screened by timber along the right-of-way. The maximum length of haul of grubbed materials was about 1,000 ft.

Several Soil Types Encountered

Various soil types were encountered in the grading operations. Classified on the basis of location along the highway, percentages of each type were rock 27 percent, sand 23 percent, clay 36 percent and muck about 14 percent. Based on PRA classifications, the subsurface materials encountered were A-2 glacial till boulder clay, A-3 clean uniform sand, glacial gravels, A-5 cohesionless silts in thin strata only, A-6 plastic silty clays and A-8 organic humus. About 80 percent of the rock and muck occurred in the southern half, with sand and silty clay in about equal proportions predominating in the northern half. Although most of the sands were suitable for A-3 embankment material, only occasionally was good gravel found within the right-of-way.

In the area that was predominently of clay, the material for a depth of 10 ft was generally a compact brown clay formation. Beneath this, blue-gray plastic clay was frequently found. Tests indicated these clays to be quite stable when protected by an overlying layer of granular material and generally satisfactory for embankment and roadway base.

The Saco River forms a dividing line of the rock types. North of the river, fissile somewhat highly weathered and shaly rock of sedimentary origin was found, while south of the river were granite and quartzite frequently cut by dikes and lenses of diabasic trap rock. These rocks showed only slight weathering at the surface.

Excavated material was fully utilized in building embankments. Grades were generally established several feet above natural ground to facilitate drainage and snow removal. The number of cuts required was held to a minimum. The depth of the maximum cut was 27 ft. Approximately 96 percent of the roadway excavation was salvaged for fill.

Because of the rolling terrain groundwater depth varied. In swampy locations and flat areas bordering brooks and streams it was encountered at or near the surface. On higher ground with good drainage and sandy soil no groundwater was encountered. Where a sandy overburden covered either a clay subsoil, an impervious silt or iron-cemented sand layer, the water level remained close to the surface. Outside the swamps the cutting of side ditches provided sufficient drainage to permit operations to proceed without undue interference from ground or surface water.

Borrow pits, although limited in depth, generally provided a face high enough for economical shovel operations. In a number of pits in flatter areas of the northern sections, primarily developed for A-3 material, groundwater was usually encountered at or near the depth of satisfactory material and therefore did not seriously restrict operations or reduce the quantities of procurable borrow.

Frost-Free Subgrade Sought

The design gave special consideration to providing a frost-free subgrade. Construction operations had to be adjusted to removal of unsatisfactory material. An A-3 select material from borrow pits was located, loaded, hauled, placed and finally compacted in place by rolling to maximum density at optimum moisture.

Since bids were taken on a unit price basis with payment made for borrow pit measurement and extra payments for overhaul and compacting embankments, the thickness of the A-3 subgrade was left to field

FOR SHORT HAULS of 1/4-mile, 12- and 15-yd Le Tourneau and Gar Wood scraper-tractor units (pictured above) are used in earthmoving operations. For hauls of 1/4 to 1/2 mile, 12-yd Tournapulls and Euclids are used, and for longer hauls of 3/4 to 5 miles rubber-tired trucks are used. Other equipment used by two general contractors includes shovels that vary in capacity from 1 1/2 to 2 1/2 yd.

EMBANKMENT MATERIAL is rolled in layers 4 to 9 in. thick. Compacting equipment includes dual-drum sheepsfoot tamping rollers, 10- and 12-ton three-wheel rollers (left), rubber-tired rollers and rubber-tired tractors. Material that does not compact under rolling is saturated or covered with 2 to 4 in. of gravel.

determinations. Several factors were involved in these determinations. Borrow-pit material was classified "satisfactory" or "qualified," depending on sieve analysis and other soil tests. Generally any material with less than 10 percent passing a No. 200 sieve was classified as "satisfactory" and considered free from frost heaving under the most adverse conditions. The "qualified" material contained a questionable amount of fines and its gradation was close to the limits of frost-heaving characteristics.

The material underlying the A-3 base was analyzed as to type, such as rock, sand, silt or clay; its position in cut or embankment noted; the approximate level of groundwater, height of embankment and probability of flood water submergence determined. Depending on such factors, the thickness of the A-3 base material was fixed varying from 1 ft to 4 ft in $^1/_2$-ft increments. The preparation of this somewhat unusual type of subgrade resulted in construction operations that differed widely from the commonly used side borrow and ditch-stripping methods of securing embankment material.

Exact figures are not available for determination of the additional cost to secure this type of embankment, but a few general observations may be offered. The average haul of A-3 material was about 1.53 miles, while the average haul of other borrow material was about 0.7 mile. The maximum haul of A-3 material was 5.5 miles, while the maximum of other borrow material was 1.5 miles. The contractor built about 16 miles of haul road for which no extra payment was made. Bids were taken on the basis of 1 mile of free haul, with the contractor naming his own figure for overhaul. On the northern half overhaul is being paid for at the rate of 8 cents per cu yd, $^1/_2$-mile haul, and the southern half, 5 cents per cu yd, $^1/_2$-mile haul.

Excavating Operations

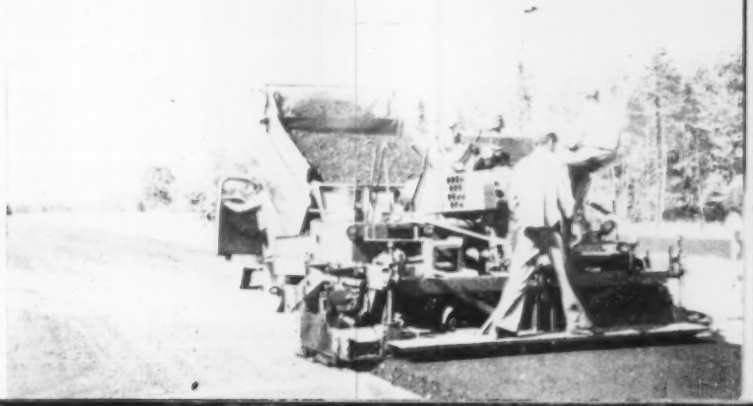
Benchmark monuments were set in the completed embankment last fall and check readings of elevations made during the winter. These readings showed an absence of heaving from frost action. Comparable monuments set in adjacent natural ground showed considerable vertical displacement in the winter period.

Some 263,000 cu yd of rock were excavated in grading operations, with a maximum of 4,780 cu yd in one station length. Rock excavation proceeded generally by drilling holes 5 ft on centers and shooting 150 to 175 holes at one time. The charge, Hercules 60 and 40 "Gelamite" dynamite, varied with the depth of hole, 5 to 6 ft being used in a 22-ft hole.

The specifications stipulated that all embankment material was to be rolled in layers 4 to 9 in. in thickness. The contractors used various types of rollers for this phase of the work, including dual-drum sheepsfoot tamping rollers, rubber-tired rollers, rubber-tired tractors and 10- and 12-ton three-wheel rollers. Where the material was such that it did not compact under rolling, thorough saturation was required. In some locations where the sand lacked fines, the uniform size of the material made compaction impossible even with saturation. In such cases 2 to 4 in. of gravel was spread over the area before satisfactory compacting resulted.

The two major bridge structures are over the Saco River and the

ASPHALT MIX PLANTS (below, left) are located at Station 786 for south half and at Station 1625 for north half of 44-mile section. Asphaltic concrete hauled to site in 2- to 4-cu-yd dump trucks is placed by Barber-Greene pavers (below, right) adjustable to 8- to 12-ft widths. Pavement consists of 5- to 6-in. base course with 2-in. wearing surface.



York River. The Saco River crossing is a six-span continuous structure. Each of the twin superstructures of the bridge, on 50-ft centers, has a roadway 28 ft between curbs. Of conventional design, the superstructure consists of a reinforced concrete slab on deck steel girders. The design is unusual in that the twin superstructures are supported on common piers. The piers are of concrete, supported on timber piling driven to rock.

Owing to an existing dam on the river below the bridge site, floating equipment could not be brought in by water. The contractors used barges built up from C.B. pontoons of the type developed by the Navy during the war. Pontoon units were hauled to the site, launched and assembled. Crawler cranes run onto the barges furnished needed equipment for floating operations. Concrete delivered to the site by truck from a ready-mix plant 15 miles away was placed by pumpcrete machines in the shafts and bases of the piers.

The York River bridge is a steel-beam-span structure with concrete-floor. Spans are 35 ft on center supported on steel pile trestle. Unlike the Saco River bridge, twin superstructures are supported on independent substructure units. For protection of the steel piles, 30-in.-dia sleeves were lowered over the pile to 2 ft below streambed and filled with concrete up to the bottom of the bent cap.

All cross roads are carried either under or over the turnpike. The underpasses are of conventional design, rolled beam spans with concrete floors supported on concrete abutments and center piers. Steel piling was used in many of the foundations of the structures.

In determining the architectural treatment of these structures simplicity of design and treatment and consistency in design of all underpasses were decided upon. These factors permitted utmost economy in construction and resulted in an adopted treatment that is typical of all the turnpike structures. The treatment included use of absorptive lining of forms on all exposed surfaces, leaving no form marks, thus requiring only nominal rubbing.

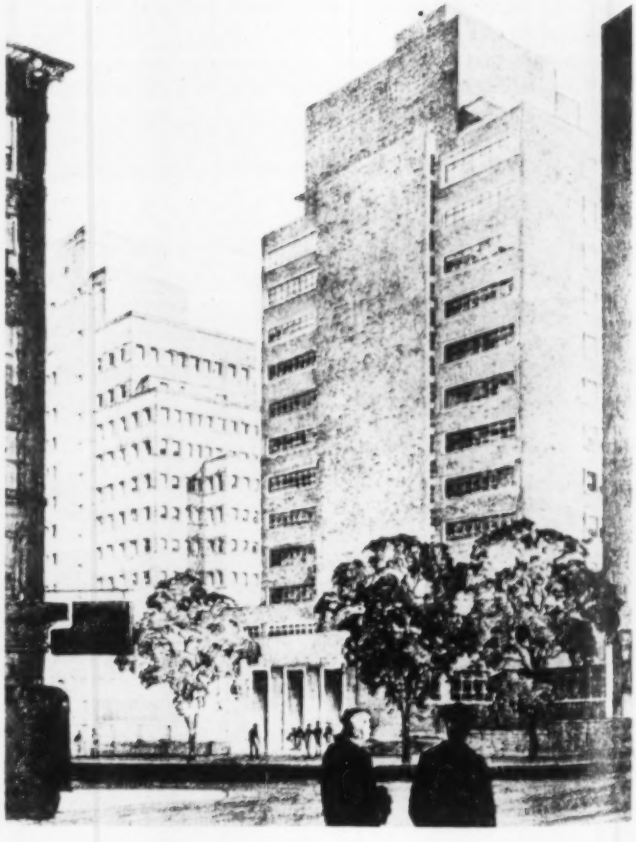
The pavement, varying in thickness from 7 to 8 in., is a hot-mix machine-spread asphaltic concrete laid in a 5- to 6-in. base course and a 2-in. wearing surface. The base course using local aggregate is laid and compacted in two layers. In the wearing surface the aggregate is a hard crushed granite obtained from a quarry near the south end of the project. The contractor assumed all responsibility in locating satisfactory aggregate. Borrow pits were subject to approval as to quality and location, but rentals, royalties or purchase costs were assumed by the owner. Geologists employed by the engineers successfully located numerous borrow pits along the length of the highway, resulting in a minimum amount of overhaul payment.

(*Continued on page 78*)

ROCK CRUSHING EQUIPMENT includes Cedar Rapids crusher at south pit (Station 658) and Pioneer crusher at north pit (Station 1625), each with capacity of 250 tons per hour. Portable plants at each pit handle screening and grading of aggregates.

New $2,000,000 Cancer Institute

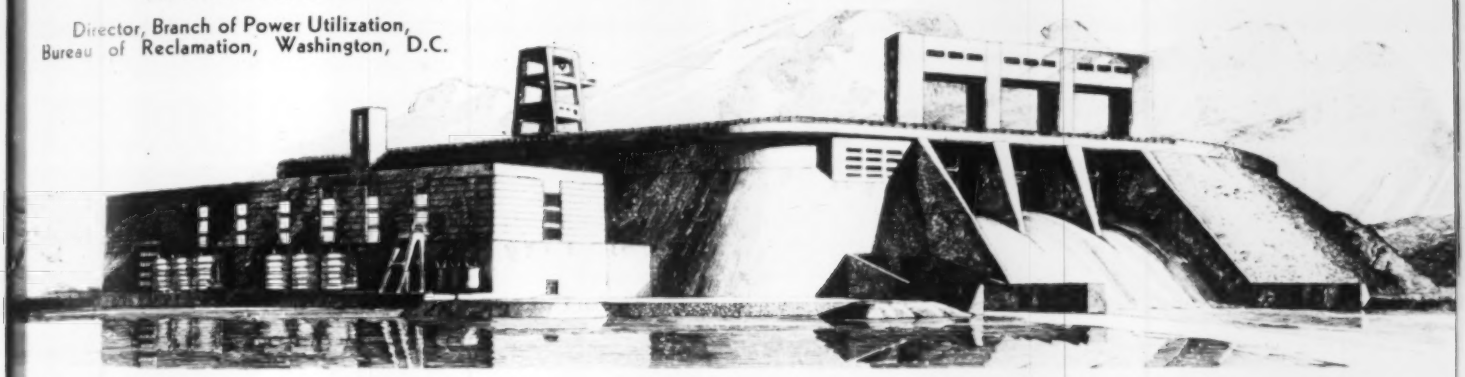
ERECTION OF structural steel is well advanced on $2,000,000 Sloan - Kettering Cancer Institute, part of Memorial Hospital in New York City. Special precautions were taken in excavation work to guard against vibrations that might damage vital, precise instruments used in handling radium and other materials in adjacent Memorial Hospital. City block occupied by Memorial Cancer Center was gift of John D. Rockefeller, Jr., in 1936, who at that time gave $3,000,000 to erect present hospital. Designed by Skidmore, Owings & Merrill, building is being erected by Turner Construction Co.



Proposed Projects Develop Power and Irrigation Potentials of Colorado River System

H. F. McPHAIL

Director, Branch of Power Utilization, Bureau of Reclamation, Washington, D.C.



DAVIS DAM in Pyramid Canyon, 67 miles below Hoover Dam, completes structures necessary to develop feasible power heads on lower 550 miles of Colorado River.

COLORADO RIVER RESOURCES, already responsible for crop-producing irrigation on land that previously was desert and for fast-growing cities which owe their growth to its life-giving water although they are hundreds of miles from the stream, have barely been tapped. Power possibilities alone are such that the presently developed capacity, large as it seems in comparison with early-day evaluations of potentialities, can be more than trebled. The entire Colorado River drainage area presents a future possibility of more than 3,600,000 kw of additional capacity, and nearly 20 billion kwhr energy production, as compared with present development in operation or under construction of about 1,500,000 kw, and 7.2 billion kwhr of annual production. The Bureau of Reclamation proposes to combine the development of power and irrigation features to assist the repayment of the irrigation costs through the application of power revenues for this purpose. A survey of the present development of the Colorado River and an analysis of the possibilities arising from full development of the vast Colorado River Basin are presented in this paper.

ALTHOUGH PROVIDING DRAINAGE for an area of approximately 242,000 square miles in the seven western states of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming, the Colorado River has to this date undergone only a meager beginning in the development of its potential resources. This is particularly true of its possibilities as a source of hydroelectric power.

The Colorado River system originates in the high mountains of Wyoming on the Green River tributary and in the Rocky Mountain area of Colorado on the Colorado River (see Fig. 1). These two areas are estimated to contribute about 33 percent and 41 percent, respectively, of the average annual runoff. The river is peculiar in that almost immediately after leaving the high mountain area and practically coincident with crossing the Utah state line, it enters deep canyon sections which, with only minor exceptions, continue far to the south where the river emerges into flat country on the Arizona-Nevada boundary a few miles below Hoover Dam.

For many ages the Colorado River has been a tremendous carrier of silt. The awe-inspiring canyon sections, of which the Grand Canyon is best known, bear mute testimony to this. Evidence indicates that the Imperial Valley in California was formed by the river delta's isolating the northen end of the Gulf of California. The river has probably alternated its route several times in ages past, at times sending its flow

PARKER DAM, constructed with funds advanced by Metropolitan Water District of Southern California, provides reservoir from which water is pumped into District's aqueduct for use in coastal areas of southern California. Average annual power output of dam is 500 million kwhr.

FIG. 1. COLORADO RIVER PACT, formulated by representatives of various states in river basin and approved by Congress in 1921, divides waters between upper and lower basins.

into this valley and at times into the Gulf as governed by the level of its silted bed and the effect of floods of large magnitude.

It was not until the beginning of the present century that the Colorado River was fully recognized, not only as an asset but as a menace. Its break-through into the Imperial Valley in 1906 established without argument its status as a menace. About this same time its value as an asset became so apparent that the upper basin states of Colorado, New Mexico, Utah, and Wyoming became fearful that lower basin states might, on account of the extensive development ahead of the upper basin states, establish prior use rights which would prohibit substantial upstream use.

As a result, representatives of the various states met in 1920 and formulated a plan resulting finally in Congressional approval, in August 1921, of the Colorado River Compact, which divided the waters of the river between the upper and lower basins. The compact became binding in 1929 when the legislatures of six states, Arizona being the exception, ratified it. Arizona subsequently ratified the compact in February, 1944.

Although the compact was an important step forward in dividing the waters of this river, it was only a beginning. The waters still must be further divided between the states in each basin. This is a complicated and vexing problem now receiving the attention of the interested states, as well as of the federal government. The problem is not made easier by the present full realization of the value of the waters and a determination on the part of each state to get its maximum share.

Up to this date there are relatively few dams on the river. Two of these are in Colorado and are of comparatively minor magnitude. One is the Colorado River diversion dam on the Grand Valley Project of the Bureau of Reclamation, and the second is the diversion dam for the Shoshone power plant of the Public Service Co. of Colorado near Glenwood Springs, Colo. At this latter site 14,400 kw are developed. All other dams are in the lower basin at Hoover Dam and below.

Of the lower basin dams the Laguna Dam, about 13 miles upstream from Yuma, Ariz., is the oldest. It was completed in 1909 to provide diversion of water for the Yuma Project of the Bureau of Reclamation. It is of the concrete-paved, rock-fill, overflow type, is 4,780 ft long, and raises the water surface about 10 ft. It does not provide for power development.

POSSIBILITIES arising from the full development of the vast area in the Colorado River Basin are enormous. In national benefits the results of such development will be equivalent to adding another state or two to the West. The developed area will offer an outlet for a substantial part of our increasing population, offer further opportunity for decentralization of industry and, with the advent of low-cost power, make it possible to develop economically many mineral resources vitally needed by the nation, many of which up to the present time have been untouched owing to their remoteness from sources of power supply and transportation. Industrialization of the mineralized areas will result in new communities arising which will contribute to the demand for farm produce. This demand will give the farmer a broader market for the crops he will produce through the development of the irrigation features.

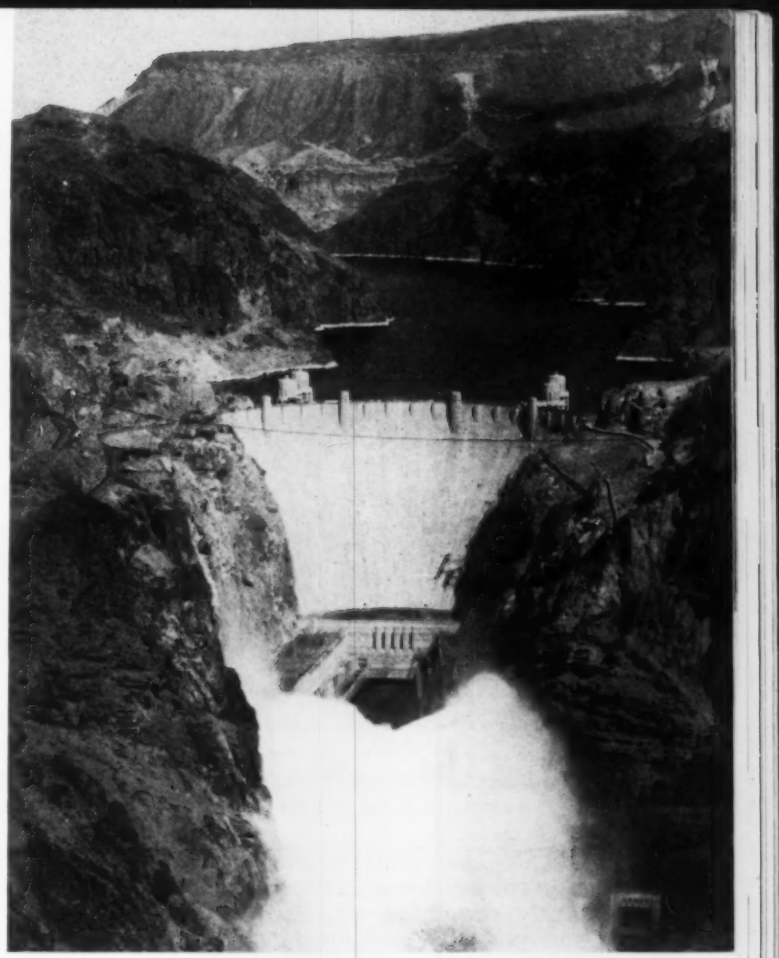
Physical Data on Hoover Dam

The real harnessing of this stream began with the construction of the Hoover Dam by the Bureau of Reclamation. The first appropriation for this structure became available in 1930 and the first water was stored in 1935. Power development first started in 1936. The physical data regarding this highest dam in the world and presently largest power plant in the world are briefly as follows:

Type: Concrete gravity arch. Height: 726 ft above foundation; 576 ft above normal tailwater. Thickness at base: 660 ft. Length at crest: 1,244 ft. Spillway capacity: 400,000 cfs. Reservoir capacity: 32,360,000 acre-ft. Installed power capacity: 1,034,800 kw. Ultimate power capacity: 1,322,300 kw. Average annual output: 5 billion kwhr.

This multipurpose structure provides flood control, silt control, irrigation and domestic water storage, and important recreational facilities in addition to its power production. The latter feature is the one that is looked to for repayment of the federal investment.

While Hoover Dam was under construction, work was initiated on the Imperial Dam about 18 miles above Yuma, Ariz. This dam was required in connection with the All-American Canal and the Gila Projects of the Bureau of Reclamation. This dam is of the concrete, overflow type and raises the water level of the river about 23 ft. It is 3,485 ft long with diversion works for the Gila Project on the east end and for the All-American Canal on the west end. It contains no provision for power development. Of particular engineering interest are the silt removal facilities of unprecedented magnitude in connection with the All-American Canal. Seventy-two Door-type scrapers are employed for handling the silt deposited in the settling basins. On the Gila Project side



HOOVER DAM, completed in 1935, delivered its first power in 1936. Multipurpose structure provides flood control, silt control, irrigation, domestic water storage and important recreational facilities in addition to producing 5 billion kwhr average annual power output.

settling basins with flushing facilities only have been provided.

Physical Data on Parker Dam

Immediately following the construction of Hoover Dam, the Bureau of Reclamation started work on Parker Dam with funds advanced by the Metropolitan Water District of Southern California. The principal purpose of the dam was to provide a pool from which the water district could pump water into its aqueduct for use in the coastal areas of southern California. Incidentally it provided a power head of 75 ft which permitted the installation of 120,000 kw of capacity. The federal government has rights to one-half of this capacity and the district to the other half. At present the Bureau of Reclamation operates the entire plant under a lease arrangement for the half capacity owned by the district. Probably the most interesting engineering feature of this dam is that over three-fourths of the height is below the water surface because of foundation conditions.

The important physical data are as follows: Type: Concrete variable-radius arch. Height: 320 ft above foundation; 75 ft above tailwater. Thickness at base: 100 ft. Length of crest: 856 ft. Reservoir capacity: 716,000 acre-ft. Power capacity: 120,000 kw. Average annual output: 500 million kwhr. The dam was completed in 1938 and power generation started in 1942.

During this same period the Office of Indian Affairs constructed the Headgate Rock Dam about two miles upstream from Parker, Ariz. This is an earthfill dam about 12 ft in height which backs water practically to the tailrace of the Parker power plant. While no power is presently developed at this site, if the expected degradation of the river bed below the dam takes place, an ultimate head of about 30 ft may exist. This would warrant the installation of about 40,000 kw. The dam was completed in 1940.

Physical Data on Davis Dam

There remains on the main stem of the Colorado River below Hoover Dam only one site feasible for development of hydroelectric power. This is the Davis site, about 15 miles above Needles, Calif., where the Bureau of Reclamation is currently constructing an earthfill dam and a power plant of 225,000 kw capacity. It is expected that this installation will be completed in 1949.

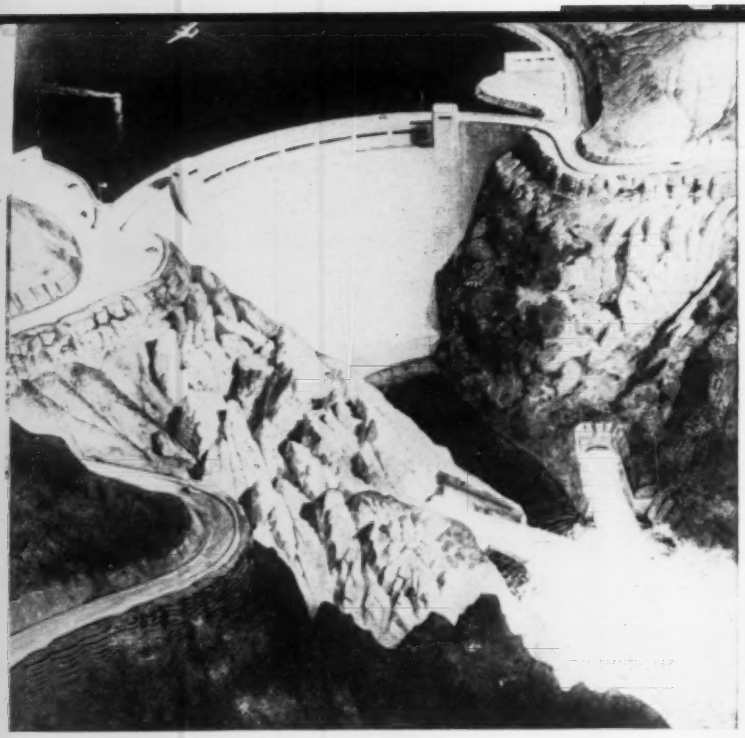
The physical data are as follows: Type: Earthfill. Height: 200 ft above foundation; 130 ft above tailwater. Thickness at base: 1,400 ft. Length of crest: 1,300 ft. Spillway capacity: 200,000 cfs. Reservoir capacity: 1,600,000 acre-ft. Power capacity: 225,000 kw. Average annual output: 900 million kwhr.

In addition to the main-steam developments, about 71,000 kw have been developed in eight hydro plants on the Salt River and the canal system in connection with the Salt River Project, and 10,000 kw at Coolidge Dam on the Gila River in connection with the San Carlos Project in Arizona. Also, the Imperial Irrigation District has developed a total of 14,400 kw in two drops on the All-American Canal as it flows into the Imperial Valley in California. Other minor developments of hydro power, totaling about 7,000 kw, have been made by private interests within the drainage area of the lower basin.

In the upper basin a number of small developments, totaling about 60,000 kw, have been made by various interests. The largest and most important of these is the Green Mountain development of the Bureau of Reclamation on the Blue River in Colorado. This plant is of 21,600-kw capacity with an average production of about 60,000,000 kwhr per annum. It was built in connection with the Colorado–Big Thompson trans-mountain diversion project which will develop an additional capacity of 154,300 kw on the east slope of the Rocky Mountains with the water diverted. However, power developed with water diverted into other drainage basins is not being covered in this paper.

In summary, there have been developed or are under construction a total of approximately 1,500,000 kw of hydroelectric capacity in the basin of the Colorado River with an annual production capacity of about 7.2 billion kwhr. Let us compare this situation with the potential possibilities that exist. From its headwaters to the International Boundary, the river drops from an elevation of about 10,000 ft to an elevation of less than 100 ft. This is indicated graphically by the profile sheet. The Bureau of Reclamation has investigated a great number of potential sites in this vast river basin and, while it does not consider that it has in any way exhausted the possibilities, has determined that 38 sites offer promising possibilities. These sites total 1,945,000 kw with an average annual firm generation of about 10.2 billion kwhr in the lower basin and 1,713,000 kw with an average annual firm generation of about 9.2 billion kwhr for the upper basin. Thus for the entire Colorado River drainage area we have a future possibility of more than 3,600,000 kw of additional capacity and nearly 20 billion kwhr, as compared to present development, including works under construction, of about 1,500,000 kw and 7.2 billion kwhr of annual production.

Of the many potential developments, there are a few of outstanding importance from a power standpoint which deserve special mention. In



BRIDGE CANYON DEVELOPMENT in lower Colorado Basin greatly resembles Hoover Dam, which it may exceed in height by a few feet. Reservoir capacity will be about 10 percent that of Lake Mead. Reservoir of dam located at headwater of Lake Mead will reach Grand Canyon National Park.

the lower basin power requirements definitely point to the desirability of the earliest possible construction of the Bridge Canyon development. The topography of the site calls for a dam greatly resembling the Hoover Dam and probably exceeding it in height by a few feet. However, the reservoir area is not comparable to Lake Mead behind Hoover Dam, and its capacity will be only about $3^1/_2$ million acre-ft, or about 10 percent of Lake Mead. The site is immediately at the headwaters of Lake Mead and the dam will back up water to the Grand Canyon National Park.

The proposed power installation is 750,000 kw and the average annual output will be about 2.5 billion kwhr. This dam will stop the silt from moving into Lake Mead, but unfortunately, with the relatively small reservoir capacity, early steps must be taken to provide additional silt storage upstream. To accomplish this purpose the Bureau of Reclamation proposes the coincidental construction of two additional dams. One is the Coconino Dam on the Little Colorado, which contributes about 13 percent of the Colorado River silt burden, and the other, the Bluffs Dam on the San Juan River, which contributes an additional 22 percent of the silt burden. Power development is not contemplated at the Coconino Dam, but an installation of 52,000 kw and an average annual output of 289 million kwhr of firm energy is proposed at the Bluffs Dam.

Glen Canyon Dam

It is logical that the Glen Canyon Dam, just below the Utah state line, should follow Bridge Canyon in an orderly development of the river's power possibilities in the lower basin. It would involve a dam raising the water surface about 401 ft and providing storage capacity of about 8.6 million acre-ft. A power installation of 400,000 kw and an annual average firm generation of 2.2 billion kwhr is proposed. Also, it will provide complete silt protection for the Bridge Canyon Dam and greatly increase the firm production there.

Two additional developments are required to complete the full use of the possibilities of the main river in the lower basin. These are the Marble Canyon Dam and the Kanab Creek development. Marble Canyon, proposed to have a power installation of 22,000 kw and an average annual generation of 164,000,000 kwhr, will also act as the diversion dam for the Kanab development. Sufficient water to preserve the scenic effect of the Grand Canyon will pass through the turbines at Marble Canyon and the rest of the water will be diverted for the Kanab power plant.

The Kanab plant will be supplied by a tunnel about 45 miles in length to by-pass the Grand Canyon National Park. At Kanab Creek this water will pass through a head of 1,100 ft to reenter the river. An installation of 1,250,000 kw and an average annual output of 6.5 billion kwhr of firm energy are contemplated.

With these various developments, the Colorado River below the Utah state line will be fully controlled and regulated. No longer will the river erode the banks and gather any silt burden from its main channel. The primary silt problem remaining will be the adjustments involved in the stabilization of the channel immediately below Davis Dam and from Headgate Rock Dam to the Mexican border.

The potential upper basin developments, while many times more numerous, are, in general, of much smaller capacity and less spectacular than those in the lower basin. As these developments are still in the planning stage, only a general description of them can be given at this time. The complete upper basin development can best be visualized by taking the individual dams in accordance with their location on the rivers and not necessarily in accordance with their importance.

The Dark Canyon site is about 182 miles upstream from Glen Canyon. The dam at this site would provide a hydraulic head of 432 ft and a reservoir storage of 1,400,000 acre-ft. A power plant of 350,000-kw capacity is contemplated with an estimated annual output of 1,800,000,000 kwhr of firm energy. This dam will be located at the headwaters of the lake formed by the Glen Canyon Dam and it would, in turn, form a reservoir extending 100 miles up the Colorado to the Moab damsite.

The plan for the Moab project includes a concrete gravity dam which would raise the water 138 ft. A power plant with a 60,000-kw capacity could be installed which would produce 344,000,000 kwhr of firm energy annually. The reservoir formed by this dam will extend some 40 miles to the Dewey damsite.

The Dewey Dam would be multiple purpose for power, silt retention, flood control and river regulation. The power plant would have an installed capacity of 140,000 kw and would produce 800,000,000 kwhr of firm energy annually. The reservoir formed would extend 55 miles up the Colorado River.

The next site on the Colorado River is Gore Canyon some 250 miles upstream near the headwaters of the Colorado. There, near Kremmling, Colo., the river falls 360 ft in 4 miles. The drop would be used to generate power by constructing a low diversion dam at the head of the canyon and a tunnel to convey the water to a power plant at the lower end of the canyon. With an installed capacity of 30,000 kw, the plant would generate 177,000,000 kwhr of firm energy annually.

Lower End of Upper Colorado

Returning to the lower end of the Upper Colorado River Basin, you find that the San Juan River flows into the Colorado between the Glen Canyon and Dark Canyon damsites. The Glen Canyon Dam would back water up the San Juan River some 30 miles to the Great Bend damsite.

The Great Bend Dam would raise the water surface approximately 220

ft above the maximum Glen Canyon reservoir elevation and form a reservoir with a capacity of 1,000,000 acre-ft. A power plant here with an installed capacity of 36,000 kw would produce 203,000,000 kwhr of firm energy annually. The reservoir formed would extend approximately 40 miles upstream to Slick Horn Canyon.

A power plant at Slick Horn would have an installed capacity of 30,000 kw and would produce approximately 176,000,000 kwhr of firm energy annually. The dam would raise the water elevation about 200 ft and form a reservoir extending 37 miles to the Gooseneck damsite.

The Gooseneck power plant would have an installed capacity of 30,000 kw and produce 152,000,000 kwhr of firm energy annually. The dam would raise the water surface approximately 180 ft and form a reservoir extending to the Bluff Dam, which has been described previously.

Far above the Bluff damsite on streams that flow into the San Juan are a number of potential power developments. The largest of these is the Lime Creek power plant with an installed capacity of 40,000 kw and Kendall Mountain power plant with an installed capacity of 12,000 kw. These two plants would have an annual output of 192,000,000 kwhr of firm energy.

Green River Damsite

The Green River flows into the Colorado above the Dark Canyon damsite. The lowest damsite on the Green River is Rattlesnake. A dam located here would raise the water 250 ft and create a reservoir with a capacity of 500,000 acre-ft. The power plant would have an installed capacity of 78,000 kw and an annual firm energy output of 434,000,000 kwhr. The reservoir would extend some 28 miles up the river to the Desolation Canyon damsite.

The Desolation Canyon Dam would raise the water 250 ft and form a reservoir with a 900,000 acre-ft capacity. The power plant would have an installed capacity of 78,000 kw and an annual production of 43,000,000 kwhr of firm energy.

The next potential project is the Split Mountain power plant. A dam here would raise the water elevation 118 ft. By extending pressure conduits from the dam to a power plant located 8 miles downstream, a power head of 200 ft could be developed. The plant would have an installed capacity of 90,000 kw and would produce 846,000,000 kwhr of firm energy annually. The reservoir would be comparatively small—about 320,000 acre-ft—and stream flow would be regulated by the next upstream development, Echo Lake.

A dam at Echo Lake would raise the water surface 500 ft and would impound 5,560,000 acre-ft of water. A power plant would have an installed capacity of 120,000 kw and an annual output of 668,000,000 kwhr. The reservoir would back water up to the Red Canyon damsite on the Green River and to the Lily Park damsite on the Yampa River.

Three Power Plants on Yampa River

There are sites on the Yampa River for three power plants: Lily Park with an installed capacity of 10,000 kw; Cross Mountain with 18,000 kw; and Juniper with an installed capacity of 15,000 kw. The Cross Mountain development would take advantage of a sharp drop in the river. A low diversion dam and a 2.3-mile tunnel would develop a power head of 175 ft.

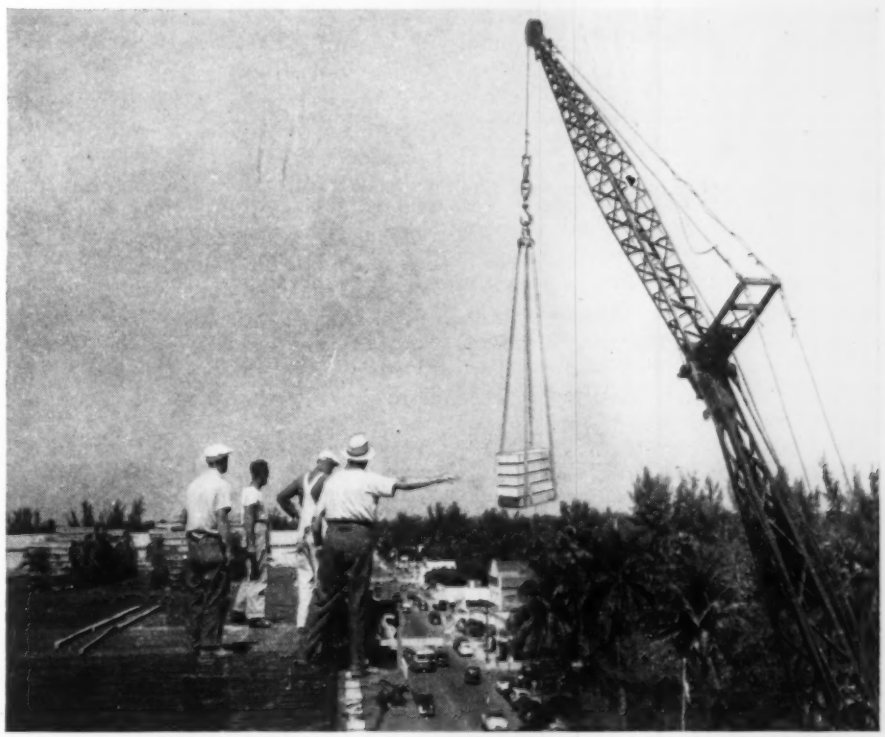
The Red Canyon Dam would take advantage of a 131-ft drop in the Green River in 3 miles. The reservoir, confined within near-vertical canyon walls, would have a capacity of only 50,000 acre-ft. The plant would have an installed capacity of 12,000 kw and an annual firm energy output of 68,000,000 kwhr.

The Flaming Gorge damsite is about 3 miles south of the Utah–Wyoming boundary. A dam would raise the water 155 ft and a 4-mile tunnel would create a total power head of 295 ft. The power plant would have an installed capacity of 30,000 kw and could produce 158,000,000 kwhr of firm energy annually.

Three power sites on the Gunnison River, which flows into the Colorado above the Dewey damsite, have been investigated.

The Whitewater damsite is 6 miles above the mouth of the Gunnison. A 200-ft dam at this site would create a reservoir with a capacity of 1,500,000 acre-ft. A power plant which has an installed capacity of 18,000 kw would have an annual output of

(*Continued on page 78*)



CRANE SERVES AS MATERIALS ELEVATOR in construction of million-dollar department store in Fort Lauderdale, Fla. Sling attached to auxiliary jib boom expedites handling of 6,400 cu ft of exterior limestone and 6,000 sq ft of glazed terra cotta facing for three-story, air-conditioned building. Other materials handled include 2,000 tons of structural steel. Spread footings dictated by unfavorable soil conditions require 4,000 cu yd of concrete and 414,000 reinforcing bars. Foundation work, mostly below sea level, requires pumping equipment capable of handling 4,000 to 5,000 gal per day. Caldwell-Scott Construction Co., of which W. W. Caldwell, M. ASCE, is president, and H. C. Scott, Assoc. M. ASCE, vice-president, are contractors on job, and Abbot, Merkt and Co. are architect-engineers.

Duluth Papers Discuss Subjects Vital To Construction Industry

Symposium on Research, Costs and Future of Industry Presented at ASCE Summer Convention

RESEARCH TO ADVANCE THE CONSTRUCTION INDUSTRY, cost control to increase its efficiency and predictions of future developments are discussed in the following articles based on a symposium of three papers presented before the Construction Division of the Duluth Summer Meeting. Advocating technological improvements to cut costs, ASCE Past-President J. C. Stevens outlines the proposed activities of the Building Research Advisory Board, now being organized by the National Research Council as a clearing house of information on building research. A. O. Babb points out the need for an accurate system of cost control to ensure economy on construction projects. Methods of obtaining better cooperation between engineers and contractors are discussed by F. W. Parrott in his paper on the future of the construction industry.

Building Research Advisory Board Serves as Clearing House for Technical Studies

J. C. STEVENS,
[PAST-PRESIDENT ASCE
Consulting Hydraulic Engineer, Portland, Ore.

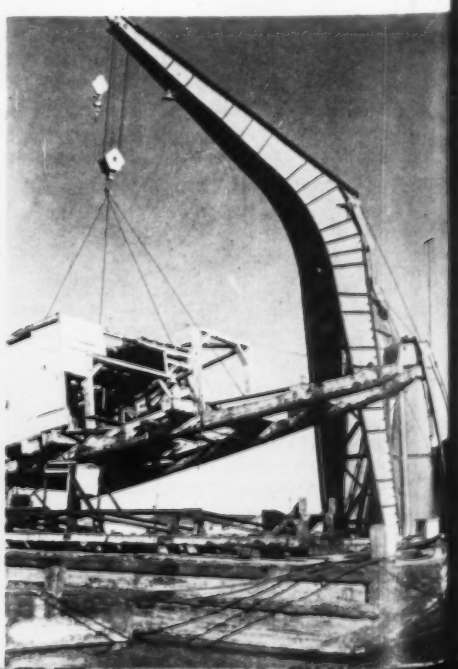
GREATER EFFICIENCY AND lower costs are desirable at any time in any industry. Under present conditions in the building industry, such savings are of the utmost importance because the industry's future usefulness and prosperity depend upon an adjustment between two diverse forces.

On the one hand is a large deferred demand for new construction. Meeting acute deficiencies in residential, commercial, industrial, educational, recreational, religious and other types of buildings will keep the industry busy for at least a decade, perhaps longer. Thus any technological improvements that can be developed to increase building efficiency and lower building costs will help not only those who must build, but also those who would like to build but cannot afford to.

The efficacy of organized research as a means of improving the prod-

TECHNOLOGICAL IMPROVEMENTS, to be promoted in future by new Building Research Advisory Board, have contributed much to growth of construction industry. Modern earthmoving equipment lays groundwork for construction of housing facilities from coast to coast. Excavating operation shown (below) is at Lakeshore Park, Calif., where more than 100 acres are being graded to provide homes for 1,500 persons. (Good Year Photo).

SILLS AND ENGINE OF PILE DRIVER (below) are moved from one barge to another at Richmond Yard, Richmond, Calif., by 30-ton Whirley Derrick on 10×44×120-ft welded steel barge. Caterpillar diesel D8800 engine furnishes power for Lidgerwood Hoist.



MANY TYPES OF CONSTRUCTION are to be studied by new research board formed by National Research Council. In view (above, left) Koehring dragline shovel loads 15-yd bottom dump Euclid on flood control project at Kanopolis, Kans., Dam that requires moving of 6,570,000 cu yd of earth and sand. Heavy construction equipment (above, right) is used for removing overburden in strip mining of coal at Pond River Coal Co.'s project in Hopkins County, Ky. Trucks operate 12 hours per day hauling rock and slate from pits. (Good Year Photos.)

ucts of American industry has been demonstrated in too many instances to require further argument. Volume of industrial research activity, as measured by dollars expended and personnel employed, showed a marked increase during the years before the war. American business no longer regards money spent in the laboratory as a gamble; it is now considered an investment.

But the construction industry has not been a leader in this activity; as a matter of fact, it is characterized by many critics as being unprogressive, to use the kindest of the epithets sometimes employed. The reason for this harsh verdict is found in the general pattern of the industry, which is composed to a large extent of small businesses unable to engage in large-scale, spectacular research activities. Such exploratory work as has been done has been carried on almost entirely by two groups; the larger materials and equipment producers and the trade associations. Because of competitive relationships there has been little coordination among the various research projects.

It is not true, as is sometimes charged, that construction has been completely blind to the potential benefits of new scientific and technical developments. But it must be admitted that its research pattern is unbalanced, stressing materials and equipment at the expense of methods; that research efforts are scattered and uncoordinated; and that there is real need of a concerted endeavor by the entire industry, to explore new ground in an effort to improve its efficiency.

A good start has been made in this direction. In 1945 the Construction Industry Advisory Council appointed a Special Research Committee to explore this subject and make recommendations for action. The Construction Industry Advisory Council had been formed under the sponsorship of the Chamber of Commerce of the United States to provide a forum for the discussion of broad problems affecting the entire industry. Membership is open to any national trade or professional association with a major interest in construction, and over a hundred such organizations, including the American Society of Civil Engineers, are now affiliated with it.

Plan for Board Approved

Last November the committee after a year of study submitted to the Council a plan that was approved without a dissenting vote. It proposed the creation of an authoritative, disinterested body of unimpeachable standing to assemble all available information relating to building construction, evaluate it without bias and circulate it on a large scale to the builders and other members of the industry, who must in the last analysis put this information to work if improved efficiency is to be attained.

In approving this new activity the Council set certain limitations upon its scope in order to keep the project within reasonable proportions. One of these is that the new organization should confine its studies to research information useful in the building field, including not only housing but also office buildings, factories and similar structures. This is an area in which public criticism of the industry has been particularly acute and one which offers wide opportunities for coordination. If, at a later date, the decision should be made to apply the same pattern to heavy construction, this could be done either by enlarging the original group or by setting up a parallel activity.

Another point to be emphasized is that the new organization will not conduct any direct research operations itself. It will function primarily as a clearing house of information on building research. Such information will be gathered, analyzed, correlated and disseminated by a full-time staff of qualified experts, being made available both through publications and by means of periodic meetings open to all interested persons, but particularly to research directors and research workers. If in the course of its operations it discovers a neglected field of research that should be cultivated, it will simply call that fact to the attention of the industry in the expectation that self-interest will induce definite efforts to carry out further explorations.

Because the success of this undertaking depends upon complete lack of bias, it is essential that the new organization be free from even the suspicion of domination by producers, fabricators, designers, real estate and financial interests, contractors or the government. All of these interests may and should participate, but no one of them

AIRPORT CONSTRUCTION—comparatively new field—has profited greatly from technological research. In photograph D6 tractor with Trackson side boom lowers junction box for runway traffic lights at Idlewild Airport, New York.

should exercise control. For this reason the decision was made to set up the research group as an independent agency.

A pattern for guiding and stimulating research on an industry-wide basis has already been established and tested. Twenty-six years ago the National Academy of Sciences, operating through the National Research Council, established a Highway Research Board, which has been very successful in stimulating and coordinating research in all phases of highway development. Establishment of a building research board by this scientific group of the highest standing would assure disinterested action by a group of unquestionable competence. Accordingly the Council approved its committee's recommendation that the establishment of such a board be formally requested of the National Academy of Sciences.

The National Research Council designated its Division of Engineering and Industrial Research to assume responsibility for the organization of what will be called the Building Research Advisory Board. The first step taken was to call a small conference of representatives of the principal independent scientific and engineering research institutes to meet with a few representatives of the building industry and of the Chamber of Commerce of the United States. At this meeting the proposal was thoroughly considered and found to be both feasible and desirable. The conference then discussed definitions of terms, limitations of scope and certain matters of general policy and mode of operation.

Organization Determined

As a result of all this consultation the form of organization, objectives, and method of operation of the Building Research Advisory Board have been fairly well settled. The Board itself will consist of from ten to fifteen outstanding leaders in industrial research and development who will serve as an over-all policy-making and directing Board for the building research activities of the National Research Council. These men will meet from time to time as necessary but will be free to continue their normal occupations. They will serve without compensation but will be reimbursed for expenses incident to attending the meetings.

Dr. Frank B. Jewett, an outstanding research executive who for many years headed the Bell Telephone Laboratories, has agreed to serve as chairman of this board. His retirement as president of the National Academy of Sciences leaves him free for this responsibility. To provide a small, representative group through which the Board can keep in close touch with the building industry, the National Research Council is asking the Construction Industry Advisory Council to set up a continuing Committee on Research Activities, which will maintain a close liaison with the activities of the Building Research Advisory Board.

To carry out its continuing operations, the Board will employ a full-time, paid staff of highly qualified experts. This staff will include a director, scientific and engineering research specialists, technical librarians and editors and the necessary clerical employees. The precise composition of the staff has not yet been determined. The intention is to start with a nucleus and add additional personnel as the work develops.

To one defining the scope and objectives of the Board its title is illuminating. The word "Building," as already explained, is to be understood as meaning building construction, including factories, homes, office buildings, and other similar structures, and will include both materials and methods—at the site and in the plant. "Research" is technologic research, together with closely related economic phases of technologic problems, but does not include research on problems which are primarily economic in nature, such as studies of methods of distribution. Also excluded are such activities as trade promotion studies and the writing or promulgation of standards, specifications or codes. The word "Advisory" in the title emphasizes the fact that the Board's work will be correlation and that it will not itself finance or direct research projects.

To Study Research

As now planned, the mode of operation of the Board will be to make a continued study of completed and active research through the staff of research men and engineers, who

SMALL MACHINES ARE ESSENTIAL to industrial building, field to which new research council will devote much effort. Fill sand for new office and warehouse building of Hibbard, Spencer, Bartlett Co. in Evanston, Ill., is loaded by ¾-yd Unit shovel powered by General Motors 100-hp diesel engine. Some 90,000 cu yd of material is required under first-level concrete slab of 16-acre structure. Shovel moves average of 720 yd of sand per 8-hr day.

will visit research organizations and by personal conversations gather the information. These same staff members will correlate the information thus collected, and the Board will disseminate it through the research agencies of the industry, possibly in the form of Research Correlation Service reports or Building Research Abstracts. The recurring staff visits will also provide a means of dissemination and correlation.

Another important activity of the Board will be the holding of periodic meetings that will provide forums for the discussion of research problems and for the expansion and maintenance of personal contacts among research workers. Such meetings have been very effective in the operations of the Highway Research Board, as well as of other groups within the National Research Council. A natural outgrowth of this activity is expected to be the formation, under Board sponsorship, of committees of research workers to study specific building problems.

The proposed Building Research Advisory Board will not be a government agency. As an arm of the National Research Council, it will have the characteristics of its parent body, which was established by executive order as the research agency of the National Academy of Sciences, established by Congressional charter in 1863. That charter directs the Academy to investigate, on request, any subject of science or technology within its fields. The stated purpose of the National Research Council is to estimate research in basic and applied physical sciences, promoting cooperation in research to secure concentration of effort to minimize duplication and to stimulate progress. While both the Academy and the Council frequently collaborate with government departments, neither of them is a government agency.

Funds to support the Building Research Advisory Board will be sought during the next few months by a special committee of the Construction Industry Advisory Council. Because it will require an appreciable time to organize the agency, secure qualified personnel, plan the program and secure tangible results, plans call for pledges from industry of annual contributions to continue for not less than five years, by which time it is expected that the value of the Board's continuation will be fully demonstrated. This period of assured support also will make it possible to employ staff men of outstanding caliber who would hesitate to accept appointment without some assurance that the activity will continue long enough to prove its value.

PORTABLE CRUSHING PLANT (right) speeds surfacing of California highway. Diesel engines drive 42 × 24-in. Cedar Rapids jaw crusher, 36 × 10-in. Austin Western jaw crusher and screening plant, and roll crusher and screening plant.

Accurate Cost Control Systems Ensure Economical Construction Operations

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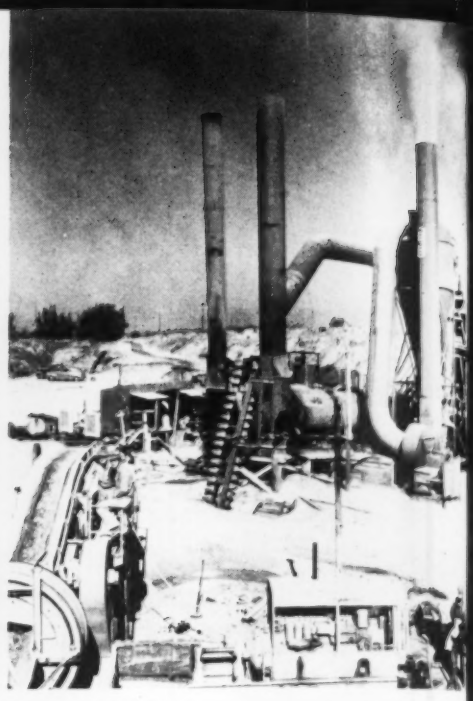
WITH CONTRACTORS ALLEGEDLY pricing themselves out of a juicy market and owners and government engineers facing costs that exceed the economic return of projects or the willingness of the taxpayer to pay, ways must be found to bring costs down. The first step in that process is to be able to throw light on all the components of cost and to analyze them through an accurate system of cost control.

Any fool can build a structure of some sort, if he is permitted to disregard all economics of design and construction and has enough material and labor to play with. We all learned during the war that, given an unlimited supply of money, miracles often resulted with the most inexperienced personnel, and the resultant project served its purpose well. We cannot continue that costly process today.

Cost control is an executive function, based on sound knowledge of a complex cost structure and an adequate basis for decisions. You can't simply buy a "system" of accounting and get cost control. Accounting can be likened to a complex and well-oiled machine going down the highways or the airways, but we have not yet developed an automatic pilot to serve as our cost control machine.

One of the most serious drawbacks to complete cost control on a project is the reluctance of organization heads, particularly contractors, to devote comparatively high-priced personnel to cost work. This is due principally to the fact that cost engineering is non-productive in a physical sense. Such executives and superintendents are often content to rely entirely on their experience and observations of the apparent efficiency with which a project is run. They fail to see that this is egotism and conceit at its worst and that they are measuring their job and their men without any yardstick.

If members of the construction industry, as a group, are to have any effect on our economy and not simply sit back and take a gambling competitive position with each other, they must use cost analysis and control to keep the slope of the



RELOCATION OF HIGHWAY 299, six miles west of Redding, Calif. (above, left), eliminates 50 curves and narrow grades. Tractors, bulldozers, scrapers, and tampers excavate, grade and tamp new 30-ft highway with total excavation of 500,000 cu yd. Deepest cut is 96 ft, deepest fill, 105 ft. Sand and crushed rock (above, right) are prepared for asphalt paving plant by diesel-driven rock crusher. Material is trucked from sand pit to crusher and then fed to hot mix plant by conveyor belt. (Caterpillar Photos.)

construction cost index just a little better than others. Contractors today are not competing with each other for jobs nearly as much as they are competing for dollars with other industries. Cost engineering is not for the purpose of telling you what a structure cost to build—the accountant will tell you that after you build it. It is to place you in a competitive and influential position where you can control the cost of structures.

In the construction field we are concerned with several disconnected major groups: the planner or designer, the accounting or record-keeping group and the poor construction "stiff" out in the mud wrestling with men and materials and trying to build something. It is in the correlation of these functions that we find the field of cost control and what has come to be known as the "cost engineer." The job to be done by the cost engineer is to relate the financial control of the accountant to the productive work of the design and construction forces.

It is in this relationship of accounting to engineering work that we find estimates and budgets being prepared, bids being calculated, costs being distributed to work items, time and motion studies, selection of plant and construction methods and the scheduling of the job. These functions of a construction project all depend upon the relationship of the dollar, as shown by the financial accounts, to work performed or to be performed. The cost engineering job depends upon a long apprenticeship in construction and engineering work, plus a complete working knowledge of accounting principles and methods. In this field of correlation, and only here, I believe, can construction managers obtain complete control of the cost of a construction project.

Cost Engineer's Functions Listed

Whether the cost engineer is one man part time under some other name or is a large unit of a company, these are his major functions:

(a) The establishment of a cost account classification.

(b) Preparation of estimates and budgets.

(c) Cost distribution.

(d) Analysis of cost records and the components of construction costs.

(e) Comparisons of cost of alternative designs and specifications.

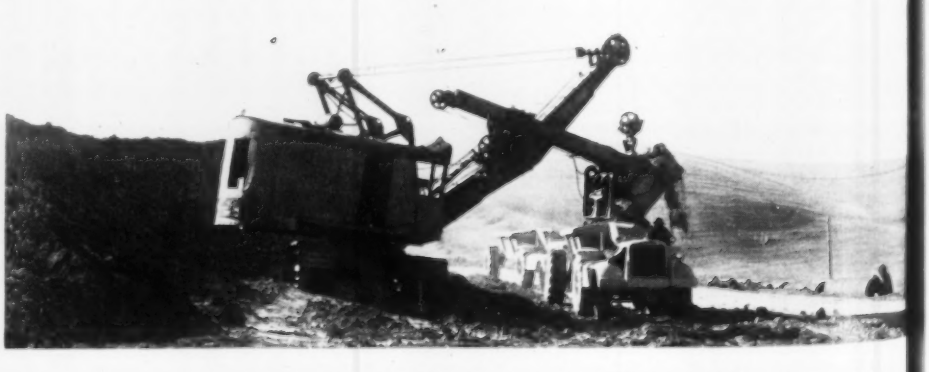
(f) Comparisons of construction methods, equipment performance, and plant layouts.

(g) Time and motion studies.

(h) Quick, accurate reporting of all types of costs.

Before this work can be reflected in top management cost control, a number of conditions are necessary. One is the willingness and desire of management to rely and act upon factual records—in other words, to bid against costs and not what they think the other man will bid. Another is the willingness of management to pay a reasonable amount for the development of costs and to recognize that cost engineering makes money more surely than guesswork.

ADEQUATE PROVISION for distribution of equipment charges, including depreciation, is essential to cost control of large construction projects. On this 450,000-yd excavation job for Willow Pass Highway, west of Pittsburg, Calif., Northwest shovel loads sandstone on Caterpillar W10 Wagon drawn by DW10 rubber-tired tractor. Each of five such units used on this $560,000 job makes 2,500-ft round trip in 12 minutes.



Another necessity, and the most fundamentally important, is the cost accounting system used on the project. The cost accounts are the main working tools resulting in actual records of cost, and no engineer or contractor or superintendent knows anything about costs without this background of actual records. He may have kept them in his head or on the backs of old envelopes, but the basis of judgment or decision is this comparative feature of results. Assuming an adequate system of accounting controls and the establishment of proper cost accounts, referred to later, uniformity of cost distribution of costs must be rigid and observed both in the estimating department and on every job throughout the organization.

It is also fundamental that the cost accounts must accurately reflect the physical progress of the work. This means actual accounting in many instances. Nine times out of ten on a big job the project accountant is the last man to arrive and to fumble with a backlog of work and the last man to leave the job because accounting is never current. Lack of a good cost accounting system that will permit fast accurate cost distribution on a current basis is the biggest single obstacle to good cost control on the job.

Systems Must Be Complete

The cost accounting system must be complete and economical. There must be no room for accounts labeled "miscellaneous" or "general," for slow, antiquated time-books and bound ledgers or for costly "pencil-pushing," where modern form design and accounting machines get the information accurately and cheaply.

Suggested rules follow:

1. A standard classification of accounts is essential for use on all projects throughout an organization. It provides a proper place for all costs to be met by that organization, determines the components of cost and how each is to be treated, distinguishes between direct and indirect charges and labor and overhead, tells what constitutes equipment charges, etc. All estimating must be based on this classification to permit direct comparison of estimates with results. It should be the Bible to anyone engaged in estimating, cost distribution or cost report work. Detail and unit costs, either actual or estimated, cannot be compared unless they are based on this same standard classification.

Cost accounts are *not* an independent set of accounts as used by some organizations. They are part and parcel of the financial accounts of the company or agency, on a double entry system, and are under a general ledger control just as cash or any other assets or liabilities of the organization. Project charges must not be dumped into a balance sheet account and an independent set of cost accounts left to shift for themselves. Such action too often results in large sums unaccounted for. This point must be given careful consideration by the large contractor or agency having many projects and offices in distant places. It is the only absolute control the fiscal accountant has over the engineer.

2. Next in line in our cost account system is an accurate and adequate method for the distribution of the payroll, both salary and hourly labor. This need varies with the size and scope of the job to some extent. But on all jobs running over a hundred or so men, involving various foremen and crafts, I believe the use of the foreman's time card for hourly labor is unquestionably the best. I know this statement will be challenged by many construction men, particularly those in some building fields and accustomed to time distribution by timekeepers. The basic steps in sound payroll procedure are: (1) Foremen educated to the job of carefully prepared time cards; (2) coding, or distribution of the time on the card to cost accounts by a competent cost man; (3) extension of the card into dollars and reconciliation with the payroll daily; and (4) posting to the cost accounts under the supervision of a qualified accountant who keeps a labor control balanced with the periodic payroll. It should be noted here that time checking is essentially a checking

FIRST 75 MILES of 156-mile Friant-Kern Canal in Central Valley, Calif., is now under construction. Man-made river, begun late in 1945, is major feature of Central Valley project that will supply water for thousands of rich but arid acres. Canal extends from Friant Dam to Bakersfield, Calif. Three Gardner-Denver compressors (above) supply air for automatic drills on section of canal that requires blasting. Bank tamper (below) covers 300 ft in seven hours.

MANY IRRIGATION PROJECTS, delayed by wartime shortages and restrictions, are now under way. Fleet of nine tractors with scrapers, bulldozers, and tampers level right-of-way, build banks and excavate top section of main canal of Columbia Irrigation Project. Work on 6½-mile section from Adrian to Stratford, Wash., includes moving 1,700,000 cu yd of earth, 340,000 cu yd of rock and 300,000 station-yd of overhaul.

job, not always necessary, and is for the purpose of protecting the payroll. It is not a function of the cost account system.

3. Accounting for material costs is, next to labor, probably the most difficult to handle, and probably more clerical labor is wasted here than in any other item of the system. Accurate control at minimum cost is usually achieved by keeping warehouse stocks at a minimum, charging materials direct to feature accounts rather than to inventory where possible and an adequate inventory control and requisition system.

4. Probably the most troublesome item to control, and one which superintendents and estimators use with greatest misgivings is equipment costs, including tractors, shovels, trucks, cranes and rigs plus the host of small tools and the expensive stationary plant necessary to do a large modern job. Any attempts at project cost control without adequate provision for the distribution of equipment charges, including depreciation, will result in failure and gross over-statements and understatements of cost. While a whole book would be necessary to cover this subject, the important accounting device is the individual equipment "clearing" or "suspense" account, which collects all costs, including the operator or crew and repairs and depreciation, and distributes them to work items or feature accounts currently on an hourly or unit basis as best suits each type of equipment. The only really satisfactory system I know of, it is often referred to as a "use-rate" basis.

At least one other important role of the cost engineer is the preparation of intelligent and usable cost reports. Too many construction managers and superintendents are content to rely on what I call historical costs. That is, they carefully estimate a job, then build it, and after the work is all done they get the completed cost figured months later to see how they made out. Such a record is interesting and valuable on the next job. Estimators can use such experience and so can designers, but it hardly gets back the wasted dollars. Full cost control on the job can only be exercised by up-to-date current cost reports, which on many operations must be made daily or on a shift basis. There is an old sports adage, "When you are playing a losing game, change it." But in order to do so, you must know what the score is, and the change must be made before the game is over.

Current Control of Costs Needed

Such items as the daily extension and reconciliation of time cards are essential elements of the pattern and, when coupled with the ingenuity of the cost engineer and supplemented by necessary spot checks and studies in the field, will result in *current cost control*. The construction man who relies on general impressions and is satisfied when men and equipment are working like the devil is often doomed to a bitter disappointment that actual records would forestall.

A number of years ago when I was working on a job involving a large rolled earthfill dam operation, some of the first of the big carry-all scrapers were produced and a couple of them tried on the job. They were hauling earth in competition with two other proved methods of excavating. Manufacturers as well as construction men were interested in the results. The machines had many bugs in them, and costs were going sky-high. Operating and repair costs the first month were triple anything experienced before, and the superintendent was sure he was wasting money. A decision had to be made quickly. Without detailed cost analysis that decision would have been to remove machines that turned out later to save over $20,000 on the entire operation. This is only one example of hundreds where the necessity of current "on-the-job" cost reports is apparent.

Probably the most important single cost report that can be devised to control a large project is the monthly cost statement, properly used. All large organizations require a monthly cost report (many contractors make it a weekly report on fast-moving jobs), but most such reports overlook the essential points of cost control. A plain financial statement of the cost to date is of little value. Such a report should always take the form of a "cost, estimate and progress report." To the contractor the estimate is his unadjusted bid at which he expects to do the work and make a profit. In addition to costs to date, the cost statement must show quantities, unit costs and the original estimate.

Then comes the important element, the extension on the job of the required cost to complete and a new total estimated cost of each bid or estimate item. This latter step must be insisted upon at least monthly on an active project. It is the guide by which the project manager can know how and where controls are most needed. It tells the cost engineer what items are in need of analysis and of spot checks of performance. It provides a ready means of forecasting overruns and underruns and changes in scope of work. Even where bid prices are not involved, this report is invaluable in forecasting financial requirements. It is like the diagnostician's report before the sur-

gram begins to operate. Its successful preparation guarantees accurate engineer's estimates and up-to-the-minute accounting records that truly reflect the physical progress of the work.

No one of the features mentioned will give the construction manager good cost control. Each is an essential ingredient of the job and the omission of any one will result in lost control on the project.

These "on-the-job" elements are for the superintendent or construction head of the project. They presuppose a carefully prepared original estimate established in accordance with the standard classification. Many failures are the result of faulty estimates, and high unit costs on the job are sometimes good costs that cannot be improved on under existing conditions.

There are many other important aids, including production records; cost indices and trends; material price control records; labor efficiency records; equipment production, operation, repair, and depreciation curves; plant and property records and analyses of overhead and continuing charges.

General Observations

Here are some general observations that I believe are axiomatic:

(1) The money spent to get and keep good cost records is in itself a cost item and must be controlled.

(2) Uniformity in the distribution of costs is essential.

(3) Unit costs cannot be used for comparison or control on other jobs, unless they are kept on a comparable basis.

(4) A mere statement of unit costs or feature costs, without the engineer's explanation and a knowledge of the components, is generally useless and apt to be misleading.

(5) Simplification and elimination of costly detail is essential to success. Do not set up detail accounts unless your decisions and your judgments on the conduct of the job would actually be influenced by the answer. The detail breakdown of accounts must be tailored to each job.

(6) Accounting and cost engineering are two separate fields of activity and must not be confused. While they supplement each other and overlap to some extent, one deals with money and the other applies money to ways and means of doing productive work.

One important plea should be made before this Division. That is for the standardization of construction cost components and terminology. In the construction industry great strides toward standardization have been made in technical terms and in materials, from giant steel beams to paving bricks. Not so with construction costs. We all read TRANSACTIONS, CIVIL ENGINEERING and other publications covering construction matters, and we see occasional references to costs and even unit costs. They are few and far between, however. Most published current data are limited to labor rates and material prices or production data. The reason is clear. Most in-place unit costs would be meaningless to the average reader. When contractor "A" says he is moving a certain class of dirt for 25 cents a yard, contractor "B" doesn't know whether that is good or bad. What is the 25 cents? What is meant by unit cost? The term "labor" or "material" look simple enough for superficial use; so does "equipment operation." But when you dig in and sharpen your pencil you begin to flounder. Is labor also compensation insurance, taxes and social security? What about the effect of freight, taxes, warehousing, handling charges and waste on the material cost? In equipment operation costs where is the operator or the depreciation factor or the major overhaul? And lastly, overhead has yet to be defined in an understandable and usable manner.

Those of you who have done cost distribution and estimating work will realize this crying need for definitions and uniformity before we can talk costs intelligently to each other. No greater service could be contributed to the advancement of construction cost knowledge than for the Society and the Construction Division Committee on Basic Accounting Procedure to find a practical solution to this problem.

Reduction of Costs Needs Cooperation of Owners, Engineers and Contractors

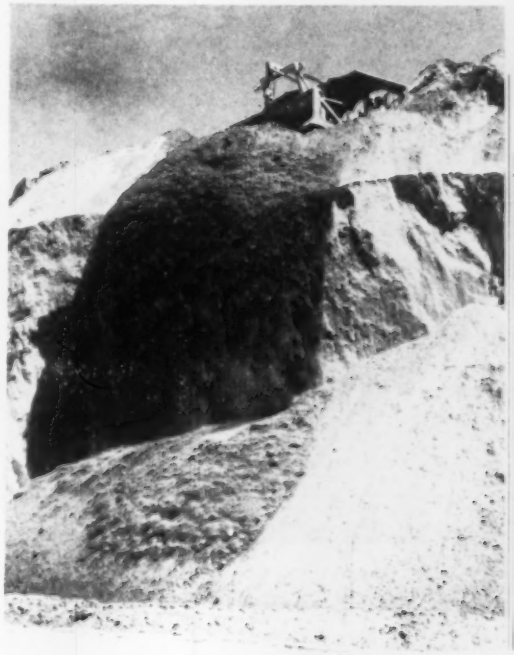
F. W. PARROTT

President,
Associated General Contractors of America,
Washington, D.C

THE FUTURE OUTLOOK for the construction industry is the same as the future outlook for the United States of America. Next to agriculture the greatest industry in the nation, it provides the facilities through which our economic, social, health, and cultural activities are conducted.

It should be treated as a basic industry, fulfilling a public demand, and when its products are paid for with public funds, they should be of direct benefit to the general public and should be provided through methods entailing the least cost.

There can be no doubt that a tremendous volume of construction is needed in this nation for many years, both to make up for the wartime backlog and to care for the needs that are being created by growth and progress of the country. More than $10,000,000,000 in construction projects is known to be in the blueprint, or completed plan stage, in



MORE THAN 700,000 YD of earth are moved for section of Coachella Canal, part of All-American Canal System in Arizona, California, and Nevada. D8 Tractor with Le Tourneau bulldozer (right) makes stockpile of dirt for canal banks.

CRAWLER TRACTOR ATTACHMENTS reduce stump-removing time for Washington contractor on land clearing job. Issacson Klearing Blade replaces dirt blade usually mounted on frame of bulldozer on International TD-14 tractor. Blade teeth get purchase on subsoil roots and tear them out with lifting power of hydraulic system. Tree roots are exposed (above) and stump is down. After clearing, teeth comb soil to remove root fragments and rocks.

addition to work already under way. Identifiable projects totaling more than an additional $40,000,000,000 are in other stages of planning.

During the period when government restrictions were imposed on the start of new construction, projects valued at approximately $3,500,000,000 were denied permission to proceed. Countless others were deferred because owners did not believe the projects came within the criteria established for securing this permission or did not choose to go through the paper work necessary for approval.

Governmental restrictions on the start of new construction finally have been removed. Most parts of the construction industry for the past two years have repeatedly urged this action as the quickest way to bring about conditions under which projects could be executed most rapidly, efficiently and economically. We recognize that the responsibility for carrying out the volume of construction needed by the nation is now placed squarely upon us.

Buyers Resist Prices

But let us not fool ourselves. The situation now is such that we can price ourselves out of a market. During the past few months many construction projects have been deferred because of current costs. In my judgment this situation has been caused by the following principal factors:

1. Waiting for a considerable drop in costs.
2. Buyers' resistance to the prices of other commodities and services, which has discouraged investment for expanded business facilities.
3. Incomplete recognition and understanding of the fact that all costs and prices must be substantially above those of prewar times.
4. The fact that construction is a permanent investment.

We may complain, for example, at paying $1 a pound or more for meat, but we buy it and then forget about it. But we will think longer and harder about purchasing construction, although its price in comparison to prewar prices may have increased less. Lack of proper understanding of the cost levels that must prevail at the present time can curtail drastically volume of construction and make the future of the industry more difficult.

The price of construction is ultimately determined by general contractors in completing work to the specification of owners. Some of the factors that enter into that price are within control of the contractor; some are not. Some are within the control of engineers designing projects or supervising their construction. All responsible parts of the construction industry must work together to help bring about those conditions under which construction can be carried out most promptly, efficiently and economically so that the public receives the maximum for its investment.

Construction Costs High

Construction costs are now high. In my judgment the increase above prewar costs is about the same as the general average for most other services and commodities, and is lower than some. At their meeting in Seattle in May, members of the Governing and Advisory Boards of the Associated General Contractors of America, gave most serious dis-

PROJECTS IN COMPLETED plan stage total more than 10 billion dollars. Those in other stages of planning total additional 40 billion dollars. In photograph, tractor and bulldozer move piles into position for driving rig in constructing new slip for Annapolis ferry on eastern shore of Chesapeake Bay.

cussion to this subject, and adopted a statement setting forth their views.

First, they found that although conditions in the industry vary widely in the different sections of the country, construction costs generally have reached their peak and are becoming stabilized.

Second, belief is that the efficiency and economy with which the industry can operate will improve at a rate similar to that at which adjustments to new conditions are made by the entire economy.

Third, during a period that cannot be foreseen accurately construction costs may decline gradually until they reach what can be considered the new normal levels. But in an economy which has been subjected to the inflationary pressures of World War II, construction costs generally cannot return to levels prevailing before the war unless the nation suffers an economic catastrophe. The level at which costs will stabilize will be substantially above the pre-war one.

Fourth, the public should not be led to believe that there will be quick or drastic reductions in construction costs. There may be reductions in prices of materials and a better regulated supply, but decreases in wage rates are not foreseeable without a depression or a serious curtailment of construction activity.

Fifth, no single cause is responsible for current construction costs. Likewise no single cure can be found. Reductions in costs will come about through elimination of uncertainties in business conditions, increased productivity of workmen, a more regular supply of materials, increased efficiency by management, development of more economical methods of construction, and a number of other factors. The need is for cooperative action by all groups and individuals within the industry.

The A.G.C. recently made specific recommendations to general contractors for actions that they could take to help reduce construction costs. (See CIVIL ENGINEERING, July 1947, p. 60.) That set of recommendations concluded with the statement that it will take time for public recognition and understanding of the fact that construction and other costs must be higher if the national economy is to operate at a level to permit payment of the national debt. The public should be informed that construction costs generally have reached their peak, that as readjustments are made in the national economy improvements in efficiency and economy can be brought about in the industry, and that responsible elements of the industry are doing all within their power to carry out operations so that the public receives the maximum for its investment in construction.

Engineers and Contractors Must Cooperate

Greater cooperation between engineers and architects would read toward more efficiency in construction. On behalf of the A.G.C., the writer asks the support of members of the ASCE in an industry-wide movement to help stabilize and reduce construction costs.

There is much that both organizations can do nationally. There is more that local groups can do in their own communities, and that engineers and contractors working together can do. Specifically, the following are some of the fields in which cooperation between engineers and contractors will benefit the public:

1. Recognition that engineers and contractors are partners with the owner in a team which has the objective of completing construction

(*Continued on page 76*)

Plow Train Simultaneously Digs Trench, Lays Telephone Cable

TWENTY-SEVEN-TON PLOW, top photo, capable of cutting 5-ft slot in earth and laying cable in one operation recently installed telephone line from Washington to Baltimore. Included in cable-laying caravan is reel-carrying trailer. Cable is fed into ground through eyelet in plowshare. Plowshare is built on pneumatic-tired chassis whose motive power is three Caterpillar D8 tractors. Hydraulic mechanism adjusts plowshare to desired depth and swings it to angle for slicing. Huge Goodyear tires cushion impact and guard against damage to machinery. Operation is first of planned program that will ultimately form coast to coast voice highway linking New York with Los Angeles, through Atlanta and El Paso. Plow train (below), consisting of prime mover, rooter plow, tractor hauling cable-laying plow, and reel trailers, forms unit that roots to depths as great as 66 in., lays cable, back-fills and compacts trench.

Politics Needs Engineers

WILLIAM GOLDSMITH, M. ASCE
Former Commissioner of Public Works, Yonkers, N.Y.
President of Woodcrest Construction Co., Inc.

WE MUST FACE the fact that engineers as a class have played a virtually insignificant part in the field of government and public affairs. In the Congress of the United States, which makes the laws by which we live, only 2 of the 531 members are engineers, while there are 303 lawyer members. Of the 19,000 engineers listed in *Who's Who in Engineering* only 250 are recorded as having made any contribution in the field of public affairs, outside of their professional work. Of over 100 outstanding citizens associated with the management of an organization such as the American Civil Liberties Union, only 1 is an engineer. Among the 400 consultants at the United Nations conference in San Francisco, only 1 was an engineer. These isolated examples are only typical instances of the engineer's almost complete lack of any sense of civic responsibility and of his complete failure to participate in the affairs of politics today.

WHY, WITHIN 20 short months of the most devastating war mankind has known, must peace-loving people regard as inevitable and imminent an even more horrible war?

Why, in an era which has produced truly miraculous technical achievements in invention and production, must we still look forward regularly to catastrophic depressions with their accompanying millions of unemployed, thousands of well-equipped plants lying idle, great stores of surplus food and commodities on the one hand and great masses of people unable to satisfy their physical hunger and needs on the other?

Why is it that, even with our increased material wealth, our improvement in health, education, ease of living and greater leisure, the inhabitants of this world are no happier today than they were 4,000 years ago, and still face in increased intensity the same problems they have always known?

Problems such as these, difficult and baffling, present a decided challenge to thinking people throughout the world today.

It is not the purpose of this paper to attempt to answer these questions or to solve these problems. It is rather the thought to suggest that the statesmen and politicians, with a preponderance of lawyers, who have shaped our destinies in the past and in the present, have not been successful in solving the problems of the world, and that we engineers, with our professional and scientific training, experience and approach, can and should participate more actively in dealing with these problems.

What are the reasons underlying the lack of civic awareness on the part of the engineer? What is responsible for his marked failure to participate in governmental affairs?

To some extent, the fault lies with the nature of our profession itself. Engineering is concerned primarily with *things*, not with *people*. Engineers primarily deal with and solve purely physical, tangible problems, such as the use and relationship of materials, rather than with intangible human problems and relationships.

In great measure it is our education and training that are at fault. Engineers, like scientists and doctors, are dosed with the mathematics, physics and other physical sciences upon which their profession is based, with an appalling lack of education in the broader fields of history, economics, sociology, psychology and philosophy. The result is that we tend to give too little thought to human problems or even to our own responsibility as citizens.

As Senator Roy V. Wright states, "It is a rare exception to find an engineering college that places special emphasis upon the functions of government, or which attempts to coach its students how effectively and definitely to discharge their civic responsibility."

According to the 1940 census there were in the United States the following:

Engineers	245,288
Lawyers and judges	177,643
Physicians and surgeons	162,649

According to Legislative Reference Service as of April 25, 1947, there are in the United States Congress:

	Senate	House	Total
Engineers	2	1	3
Lawyers	60	243	303
Medicine and Surgery	0	7	7

These figures show the near monopoly that lawyers have in our legislative halls.

Fault Rests with Individual

But lack of education alone is not the answer. In large part, the fault rests with the individual engineer himself. John C. Riedel, M. ASCE, a noted engineer, states: "I think an engineer should always remember that he is a human being first and an engineer afterwards." Too many of our profession feel that activity in the field of politics or public affairs can only be at the expense of their professional progress. To them Dr. Jolliffe, of the Radio Corporation of America, replies that the contrary is true, "The engineer should break and get out of his professional shell and become a better citizen. In fact, I think a broadening of interests would make him a better engineer."

A large part of the blame is undoubtedly due to the fact that engineers, like so many other people, tend to look down on politics and politicians, and fail to realize the important part that politics plays in the world today.

When will the engineer awaken to the realization that the political, social and economic effects of a TVA so far transcend the engineering aspects of that remarkable project as to render them relatively insignificant, magnificent as they may be from a purely technical point of view?

The time has come for the engineer, the trained man of science, to leave the seclusion of his laboratory and drawing board, to look at the world about him, and to apply his scientific training and experience to the understanding and solution of the human problems of mankind.

The engineer must remember that engineering is the science of controlling the forces and of utilizing the materials of nature *for the benefit* of man. He must awake to the realization that the atomic bomb, the airplane, the mechanization of industry, must be controlled and directed for the use and benefit of mankind, lest they prove to be a curse upon mankind. Most important, he, as the creator

of these things, must share in the responsibility for the economic, social and political effects of his creations and attempt to deal directly with the problems with which the world is faced because of them. Thus far he has left in other hands, often less skilled than his own, the job of controlling the benefits of his creative work.

Political Versus Engineering Achievements

The engineer must realize that he has always had an exaggerated notion of the importance of his professional contributions to the welfare of mankind and has, by the same token, failed to appreciate or give due credit to the functions and accomplishments of men in political life whose impact upon the affairs of mankind is of much greater importance than his own.

To illustrate, let us ask: Which has affected more the world as we know it, or has contributed more to humanity?

The construction of the pyramids, a remarkable engineering accomplishment, or the contemporaneous promulgation of the Ten Commandments, by which most of the world lives?

The construction of Pompeii and the Roman Aqueduct, or the contemporaneous teachings of Christ?

The perfection of the steam engine or the contemporaneous Declaration of Independence?

The Panama Canal or the Emancipation Proclamation?

We must, in fairness, admit that our own engineering achievements are far outweighed in their effect upon the world by the efforts and accomplishments of those who control our political destinies.

Bearing this in mind, it is of utmost importance that the engineer recognize his responsibility to participate directly and actively in the affairs of government and to contribute his professional training and experience to the solution of the problems of the world.

It is not enough, as has been the custom, that he lend his aid to government merely in time of war. He must realize that his duty to participate in government and public affairs is even greater in time of peace—to the end that mankind may be assured that there will never be another war.

Livingston W. Houston, president of Rensselaer Polytechnic Institute, has this to say on this subject: "All educated people and especially professional men with specialized knowledge and experience need to become more interested in the day-to-day political decisions which are being made. Most of the difficulties which we find ourselves in today come as the result of a political indifference on the part of the people who are most qualified to give our lawmakers guidance. Only after laws have become intolerable and unworkable do we do anything about them."

"Surely the engineering approach to political problems would be of great benefit. We need to have more data and more intelligent analysis of those data, and a knowledge of the possibilities which science and engineering hold for us as political groups. Whether engineers like it or not, new advances in atomic energy and other means of obtaining power will force the engineer to participate in politics."

A step in the right direction has been taken with the organization of the Association of Oak Ridge Scientists, who, impressed by the awesome possibilities both for good and for evil resulting from their scientific accomplishments in evolving the

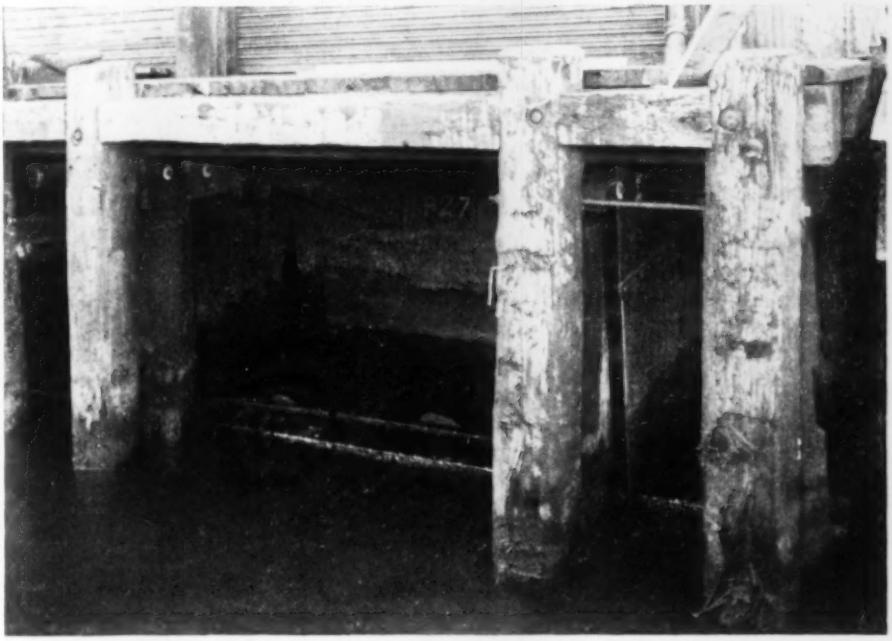
(*Continued on page 86*)

Wrought-Iron Plates Prevent Fire Spread

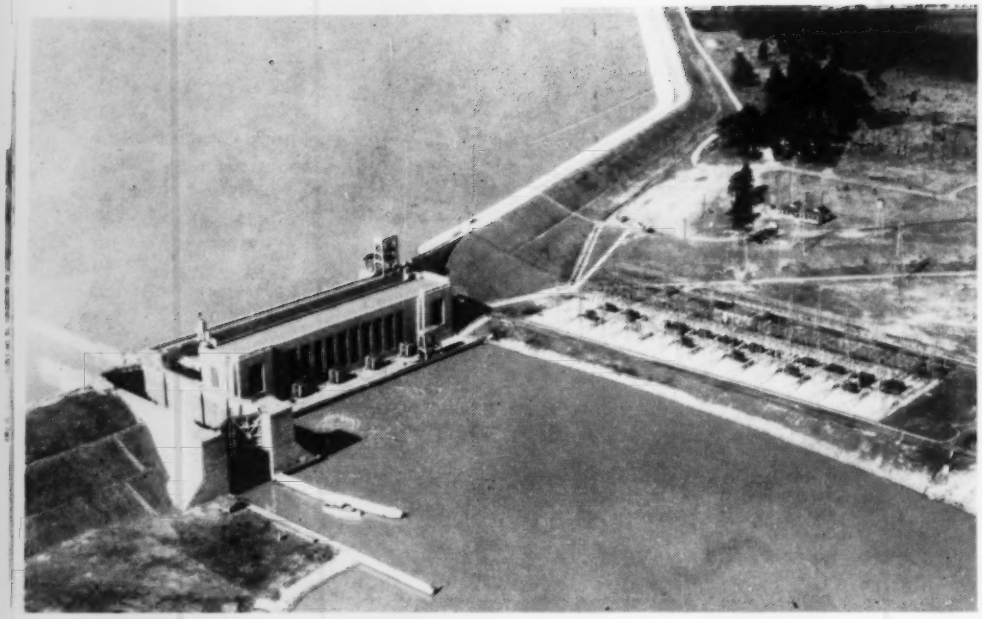
TWIN FIREWALLS of wrought-iron plate, supplemented by manually operated sprinklers, guard Norfolk and Western Railway piers at Lambert Point, Va. Designed to prevent spread of fire below decks, this protective equipment was installed recently to replace corroded reinforced concrete firewalls.

The wrought-iron fire curtains were fabricated of $^{5}/_{16}$-in. plate, notched to clear joists and stringers. They extend the entire width of each pier at intervals of approximately 300 ft. A clearance of $^{1}/_{4}$ in. was allowed between the timber and metal, 4 in. between the firewalls and the timbers to which they are bolted with $^{3}/_{4}$-in. wrought-iron bolts. These firewalls required about 175 tons of wrought iron, selected because of its durability and resistance to corrosion.

Design of the walls was supervised by W. P. Wiltsee, M. ASCE, chief engineer of the Norfolk and Western Railway; construction was supervised by J. Y. Neal, assistant engineer for the N. & W. at Norfolk; and the installing contractor was John P. Pettyjohn & Co., Lynchburg, Va.



WROUGHT-IRON PLATE at end of 1,195-ft pier, combined with three others to make 10-ft-wide chamber, constitutes double curtain of protection against spread of fire below pier decks. Sealed chamber is covered by 9-in. concrete slab over which is 3-in. layer of cinder concrete topped by 3-in. oak flooring. Open sprinkler heads protect both faces of firewall, providing spray of water to plates and protecting flooring. Curtains extend about 10 ft below decks so that they will be partially submerged at all times.



SANTEE COOPER generating plant, 32 miles north of Charleston, S.C., develops normal flow of Santee River, which is diverted into Cooper River drainage area. After passing through plant via dug canal into Cooper River, water empties into Charleston Harbor. Head on plant varies from 60 to 75 ft depending on amount of drawdown on storage reservoir, and on tidal level. Tailwater is slightly above sea level and is affected by tidal fluctuation.

Santee Cooper Generating Plant Completes Five Years of Service

Performance Record and Cost Data Presented

F. A. DALE, M. ASCE
Consulting Engineer, Cashiers, N.C.
Formerly Engineering Manager of Santee Cooper Project for Harza Engineering Co.

COST DATA on the construction of Santee Cooper Power and Navigation project in South Carolina, delayed in publication because of war restrictions, are presented herein along with a summary of the plant's performance after five years of operation.

TO REDUCE SHRINKAGE distortion and possible leakage to a minimum, special consideration was given to the pouring procedure in constructing the five reinforced concrete scroll cases in the Santee Cooper generating plant. The structure was divided radially for concrete pours and each pour was limited to a 2-ft height at 2-day intervals. This method of reducing heat rise and subsequent shrinkage proved effective because after five years no trouble has been experienced from leakage.

A vertical contraction joint was placed between each scroll case at 62-ft centers, extending from the downstream substructure wall to a point 17 ft upstream from the center line of the unit, where it was terminated in a 6-in.-dia vertical stop. These joints were grouted after the concrete had cooled. No contraction joints were provided in the substructure upstream from this point.

Steel Frame Superstructure

The powerhouse superstructure is steel frame with roof girders and columns designed as a rigid frame. The exterior walls are reinforced concrete varying from 12 to 36 in. in thickness with expansion joints 62 ft on centers, corresponding with the contraction joints between scroll cases. Horizontal temperature steel under the window openings varies from 0.8 percent in 12-in. walls to 0.5 percent in 36-in. walls. Vertical hair cracks have formed under some of the window openings indicating that even 0.8 percent steel is insufficient to prevent shrinkage cracks.

Exterior forms for the superstructure were lined with $^1/_2$-in. rough burlap-finish Celotex. Horizontal construction joints at 4-ft intervals were formed to $^1/_2$-in. V-grooves to eliminate any irregularities at these joints. The resulting concrete surface has a uniform texture and after five years shows no deterioration or discoloration except for two or three unexplained small rust stains.

It was expected that any grout drip that formed would come off with the clear curing compound that was used, when the latter weathered off. However, rather than have the appearance of the powerhouse marred for even a few years, the surface was given a light sand blasting with 10-lb pressure. Removal of any of the

POWER PLANT contains four 40,000-hp and one 13,300-hp turbines with scroll case and embedded turbine parts installed for fifth large unit. Of four large turbines, two are Kaplan type and two are fixed-blade propeller type with specific speed of 118. Floors of large draft tubes are 50 ft above sea level.

hardened concrete surface produced by the absorptive form lining was of course undesirable. Incidentally the yellow-colored curing compounds have just about disappeared from other structures of the project after five years of weathering.

Expansion space equivalent to 0.6 in. per 100 ft proved to be sufficient for parapet and guard walls which are subjected to large temperature variations. The architectural decoration of the powerhouse parapet required sharp corners, making the use of Celotex form lining impossible. These surfaces were wood formed and rubbed, and came out somewhat lighter in color than the Celotex formed surfaces.

Turbines Are Tested

The turbines were tested by a combination of flow meter and Gibson methods. The 13,300-hp unit is exactly one-third the size of the large units. The intake for the small unit was made identical in size and shape with one of the three gate openings of the large units. Below the intake gate the water passage for the small unit was contracted to a 15.5-ft-dia steel penstock with a straight section 40 ft long leading to the steel scroll case of the turbine. The Gibson method of flow measurement was therefore applicable to this installation. As is usually the case in a close coupled installation like that of the large units, neither the Gibson nor Allen method was applicable. The only way these units could be measured was by traversing the intake with flow meters; and the two-meter method, extensively used in Europe and at Safe Harbor, was adopted.

To check or calibrate the two meter results, both the two-meter and Gibson methods were used on the 13,300-hp unit. The flow meter results were then adjusted, as required, to make them agree with the Gibson method results. After thus calibrating the two-meter method on the small unit the same method was applied to the large turbines. The peak efficiency of the large turbines at 70-ft head was practically the same for the Kaplan and the fixed-blade units, namely 91 percent. The range of the Kaplan curve above 90 percent was from 55 percent to 95 percent of rated load, 40,000 hp.

Costs and other basic data have been prepared on the same basis as those presented in the January 1939, issue of CIVIL ENGINEERING, by H. G. Gerdes, so that comparison with other similar plants can be made. A plant capacity of 163,200 kw is used, which includes the presently uncompleted unit. The estimated cost of completing the installation of this unit has been included in the following costs. The plant is rated at a 70-ft head.

	Cost per Kw
Intake and substructure	$15.25
Superstructure	3.62
Turbines	12.26
Generators	12.70
Low tension, electrical	2.30
Miscellaneous powerhouse	0.45
Total	$46.58
Substructure (cu yd per kw)	0.53
Superstructure (cu ft per kw)	9.8

Substructure concrete (cost per cu yd including all embedded parts)	$23.10
Superstructure concrete (cost per cu yd including absorptive lining and reinforcing steel)	$79.40

Design and supervision of construction were by the Harza Engineering Co. of Chicago, Ill. Construction was by the Central Engineering Co. of Davenport, Iowa. The project is owned and operated by the South Carolina Public Service Authority of which R. M. Jefferies is general manager, J. H. Moore is chief engineer and J. A. Bright is operating engineer.

First Unit of Modern Building Research Center

COMPLETION OF FIRST UNIT in research center (above) and beginning of second in group of six buildings located on 93-acre plot near Bound Brook, N.J., marks progress of Johns-Manville $40,000,000 expansion program. Plans for Bound Brook center envisage largest research facilities in world devoted to building materials, insulation and allied industrial products. First unit, here shown, is being erected by Turner Construction Co. of New York at cost of $2,000,000. Rear wall, of asbestos-cement sheets, is removable to permit additions to house extra-long machinery or equipment. Special movable asbestos-cement partitions with enclosed service outlets permit enlarging or decreasing size of individual laboratory areas as need requires. Glass-enclosed promenade (under construction, below) extending down length of building has on one side laboratories and on other side experimental factories.

RADIANT HEATING COILS of 1/2-in. noncorrosive copper tubing embedded in concrete floor slab become permanent element in construction. Concrete is produced in central mix plant and hauled to job in transit-mix truck.

Assembly-Line Methods Produce 1,200 Low-Cost Homes in Maryland

ADVANCED BUILDING METHODS that include prefabrication of subassemblies enabled the construction industry to demonstrate its capacity to produce low-cost homes in record time at Harundale, an $8,000,000 veterans' housing project 5 miles south of Baltimore, Md.

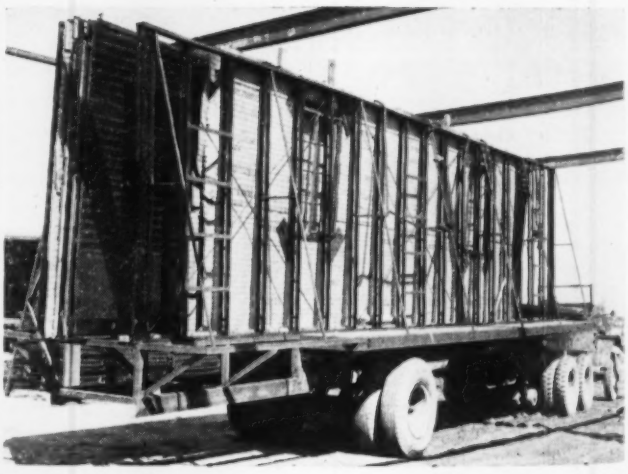
Site fabrication of complete sidewalls and roofs in mechanized, straight-line production for assembly by crane make it possible for the Byrne Corp. of Washington, D.C., to deliver daily 10 complete three-bedroom steel-framed homes with fiberglass insulation, radiant heating, stucco exteriors and plastered walls—including a landscaped 60×100-ft lot. Financed by private capital, the 26×38-ft one-story homes sell for less than $7,000.

Structural prefabrication phases consist of shop assembly of wall units and roof section. Two Quonset buildings, each 180 ft in length, with a 40-ft open extension, are used for assembly of the completed roof and fabrication of the wall panels.

HAULED TO SITE by trailer truck, roof is picked up by Marion crane (below) with 45-ft boom and swung into position on walls, interlocking into top of studs by stringer strip welded to bottom of truss. Welding of all joints completes building frame.

SUB-PANELS FOR WALL sections including steel window frames are assembled on jig tables and moved along to larger table where whole wall is assembled. Completed panel is picked up by channel head, into which it is fitted while being assembled, and carried in vertical position to working rack (right, above) where insulation and reinforcing are stud welded to one side while metal lath is attached to other. Panels are transported to field on large flat-bed trailer (right, below) equipped to carry two end walls and two sidewalls.

STEEL ROOF FRAME (below) moves along conveyor line for welding of roof truss units, placing of wood sheathing, louvers, gable ends and shingles. Process is coordinated with wall-panel production to turn out complete enclosure each hour.



Survey Shows Need for

Eight-Billion-Dollar Expenditure on Water Supply and Waste Disposal

FIRST HAND FIELD reports by United States Public Health Service engineers call for expenditure of almost eight billion dollars on water supply and waste disposal facilities throughout the United States. Their estimate is based on a comprehensive survey just completed by the Public Health Service in cooperation with state, county, and city health departments. More than 108 million Americans lack adequate water supplies and 118 million have unsatisfactory sewage disposal systems, the survey indicates. Recognizing the undesirability of providing a uniform type of service everywhere, the inventory takes into account variations in need resulting from local desires and practices.

AMERICANS NEED $7,834,581,000 worth of water supply and waste disposal facilities, the sanitary engineering division of the United States Public Health Service estimates on the basis of a nation-wide inventory of sanitation needs just completed. This figure, which represents a higher rate of expenditure than this country has seen in the past 20 years, should be reached when construction costs become more stable and labor and materials more readily available, the Public Health Service states in its report of the survey. It adds, however, "The long continued difficulty of obtaining materials, the high cost of construction for materials and labor needed for housing have made most communities continue to defer all work but that needed to meet emergency needs."

State health departments of all states, as well as hundreds of city and county health departments, cooperated with the Public Health Service in the survey. To obtain exact data on varied types and sizes of communities, engineers of the Public Health Service studied the sanitation facilities of 78 million persons in 5,800 communities. They inspected local plants, conferred with local officials, and analyzed laboratory findings of state and local health departments. Needs of unsurveyed communities were estimated on the basis of surveyed communities of similar size.

"A sanitary environment for everyone is a basic requirement of a national health program," Dr. Thomas Parran, surgeon general, declared. "By furnishing data on the volume of construction needs, the survey will guide future action aimed at providing nation-wide protection against filth-borne diseases."

More than two million persons living in communities of over 200 population have no community water supply systems and 79 million have systems needing improvements, the survey's results indicate. Fewer than 11 million live in communities for which no water supply improvements are scheduled. New sewerage systems are needed for more than six million perons in towns and cities and improved ones for 79 million; only about $6^1/_2$ million are served by adequate systems at present.

Water Supply Inadequate for 108 Million

In rural areas more than 27 million persons need new or improved water supplies and only 12 million have reasonably good water. More than 33 million rural people have unsatisfactory sewage disposal systems and only six million are reasonably well off in this respect.

To remedy these conditions, the nation needs an additional 2.2 billion dollars' worth of water works; 3.7 billion dollars of sewerage facilities;

WATER WORKS FACILITIES totaling 2.2 billion dollars are needed in this country, United States Public Health Service survey indicates. Expansion of cities brings large part of this need. Installation of fire hydrant for new subdivision of San Leandro, Calif. (above), is aided by use of pneumatic tools.

SUTRO FOREST RESERVOIR, addition to San Francisco city water supply, will serve newly developed residential area around Twin Peaks. Cut of 200,000 cu yd and fill of 100,000 cu yd (right) are required for water storage area. Extra 100,000 cu yd not used in fill is deposited in nearby depression on city-owned property. About one-third of this country's more than 2 billion-dollar water need is for development of supply resources.

UNSATISFACTORY SEWAGE DISPOSAL SYSTEMS threaten health of 118 million Americans, survey shows. Needed are more than 80,000 miles of sewers. Tractor (left), equipped with Traxcavator, Hyster winch and crane, is used for backfilling soil from sewer trench and pulling up piling on Pine Street in San Francisco, Calif.

ALMOST 80 MILLION sewerage systems need changes or additions. Four tractor-scraper combinations (above) move earth for new construction on San Francisco municipal sewer system. Cut for pipe installation is 15 to 44 ft deep and about 700 ft long.

166 million dollars of garbage facilities; and 1.6 billion dollars of all types of sanitation facilities for rural homes. These cost estimates are based on the average scale of June 1946, when building rates were indexed at 3.48 times the 1913 level of rates.

40 Percent of Construction in Planning Stage

Almost 40 percent of this needed construction is at least at the planning stage, according to the survey. More than 9 percent of needed sewerage facilities, costing approximately $360,509,000, is ready for construction now and an additional 24 percent, costing $908,048,000, is definitely planned. Almost 17 percent of the needed water supply systems is ready for immediate construction at a cost of $381,829,000, and plans are in progress for an additional 27 percent costing $612,111,000.

Two-thirds of the work ready for construction and half of that in the planning stage are in cities of more than 100,000, a classification that includes about 41 percent of the total urban population. In towns of less than 1,000 only about 10 percent of the needs will be met by projects now scheduled.

Per capita costs of needs, varying from about $23 in Rhode Island to $107 in New York, tend to be high in the states with high per capita incomes. The nation as a whole averages about $60. The high cost of work needed in some of the larger cities makes up a substantial proportion of the large state totals. Water and sewerage requirements of New York City will demand an expenditure of over $1,000,000,000. Philadelphia must spend about $450,000,000; Chicago, $220,000,000; Detroit, $150,000,000; St. Louis, $85,000,000 Pittsburgh and Allegheny County, $80,000,000; and Denver, $70,000,000.

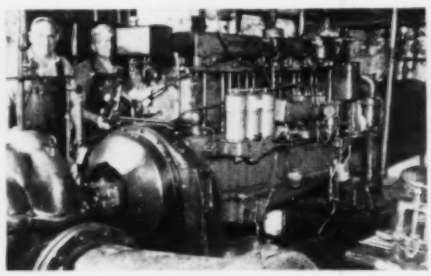
The country's largest and smallest communities show the highest per capita cost of requirements. Somewhat more than $80 per capita is needed in cities of over 100,000 population, while towns of fewer than 1,000 people must spend more than $100 per capita. In towns of intermediate size, the cost will be less than $50 per person, and in rural areas about $40.

About a third of the 2.2 billion-dollar requirement for water works is for development of water supply sources. Big items in this total are the completion of New York City's Delaware watershed supply, development of an upland supply to replace highly polluted sources in Philadelphia, and additions to Denver's existing sources of supply. About half of the water works needs is for distribution systems and approximately one-sixth for treatment facilities.

Included are 5,700 complete water works systems, most of them for towns of less than 1,000 population,

(*Continued to page 80*)

LARGEST AND SMALLEST COMMUNITIES show highest per capita cost of required improvements in water and sewerage facilities. Cost is less in towns of intermediate size and rural areas. Wartime growth of Taunton, Mass., with presence of staging center Camp Myles Standish made former supply for city water works (right) inadequate, so water is pumped from Asawompsett Lake to Elders Pond, prewar source. Diesel engine powering centrifugal pump (below) is operated 24 hr daily for 10 days, then shut down for 3 hr for oil change.



Engineers' Notebook

Area of Irregular Plots with Circular Curve Boundaries Computed by DMD Method

OLIVER D. KEESE, Assoc. M. ASCE
Office Engineer, Department of County Surveyor and County Engineer, County of Los Angeles, Calif.

FOR SOME REASON writers of textbooks on surveying have avoided any explanation of the process of computing by the DMD (double-meridian-distance) method the area of an irregular plot having circular curves in its boundary. In the office of the county surveyor of the County of Los Angeles, Calif., this problem arises very frequently. Our system might be of interest to other engineers who may be unaware that such problems can be solved by this rather simple process.

Figures 1, 2 and 3 show three typical, hypothetical plots in which a circular curve forms one line in the boundary. In Fig. 1 the curve sector is entirely outside the plot; in Fig. 2 the sector is entirely inside the plot, and in Fig. 3 the sector is partly inside and partly outside. In all three figures the dotted lines indicate the boundaries of the half areas resulting from the DMD products. We find it advantageous to compute the traverse in a counterclockwise direction starting with the most westerly corner of the plot.

In Fig. 1 the first area computed is a square of which the first course, 0-1, is a bisecting diagonal. We need be concerned only with the half of this area indicated by the letters *A* and *B*. Since the latitude of 0-1 is south, this area is negative. The next course, 1-2, is a diagonal bisecting a rectilinear parallelogram. The half area in which we are interested is composed of sub-areas *A*, *B*, *C* and *D*, and is positive.

The next course, 2-3, is the first radial line of the circular sector and embraces the negative half area composed of sub-areas *A*, *C* and *E*. Course 3-4, the second radial line, gives us the positive sum of sub-areas *A*, *C*, *E*, *F* and *G*. Note that the sector is included. Course 5-6 results in the positive sub-area *H* In this figure the remaining courses have no influence on the area.

At the right-hand end of the traverse tabulation the columns headed *A*, *B*, *C*, etc., show the progressive positive and negative characteristics of these lettered sub-areas. It will be noted that sub-areas *A*, *B* and *E* cancel out and that *C*, *D*, *F*, *G* and *H* remain positive. Sub-area *F* is the sector that must be subtracted as shown to obtain the net area desired.

The situation shown in Fig. 2 differs from that in Fig. 1 in that the area of the sector, sub-area *F*, cancels out and therefore must be added instead of subtracted to obtain the desired net area.

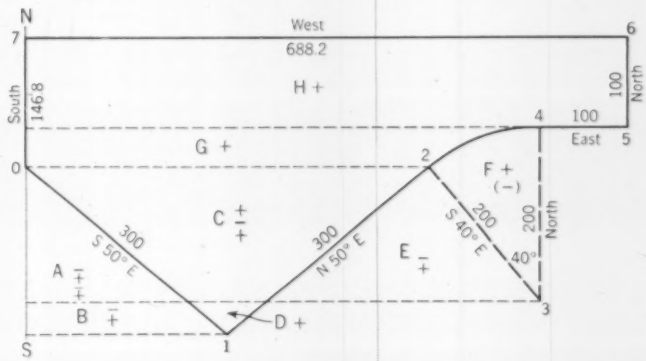


FIG. 1. SECTOR of circular curve (right) forming part of boundary is entirely outside of plot. Computations of area by DMD method are given in table below.

Course	Dist.	Bearing	Latitude N	Latitude S	Departure E	Departure W	DMD	N. Prod. +	S. Prod. −	Half Areas ± A	B	C	D	E	F	G	H
0-1	300	S 50° E		192.8	229.8		229.8		44,305	−	−						
1-2	300	N 50° E	192.8		229.8		689.4	132,916		+	+	+	+				
2-3	200	S 40° E		153.2	128.6		1047.8		160,523	−		−		−			
3-4	200	North	200.0				1176.4	235,280		+		+		+	+	+	
4-5	100	East			100.0		1276.4										
5-6	100	North	100.0				1376.4	137,640									+
6-7	688.2	West				688.2	688.2										
7-0	146.8	South		146.8			0.0										
			492.8	492.8	688.2	688.2		505,836	204,828	/	/	+	+	/	+	+	+

$$\text{Area of sector} = \frac{\Delta \pi R^2}{360} = \frac{\pi R^2}{9} = \frac{204{,}828}{2)301{,}008} = \frac{150{,}504}{13{,}963} = \text{area including sector}$$

$$136{,}541 = \text{net area sought}$$

Course	Dist.	Bearing	Latitude N	Latitude S	Departure E	Departure W	DMD	N. Prod. +	S. Prod. −	Half Areas ± A	B	C	D	E	F	G
0–1	300	S 50° E		192.8	229.8		229.8		44,305	−	−	−				
1–2	200	N 40° E	153.2		128.6		588.2	90,112			+	+	+	+		
2–3	200	S 50° E		128.6	153.2		870.0		111,882		−			−	−	
3–4	300	N 40° E	229.8		192.8		1216.0	279,437		+	+			+	+	+
4–5	704.4	West				704.4	704.4									
5–0	61.6	South		61.6			0.0									
			383.0	383.0	704.4	704.4		369,549	156,187	/	/	/	+	+	/	+

$$\text{Area of sector} = \frac{\Delta \pi R^2}{360} = \frac{\pi R^2}{4} = \begin{array}{r} 156{,}187 \\ 2\overline{)213{,}362} \\ 106{,}681 \\ 31{,}416 \\ \hline 138{,}097 \end{array} \begin{array}{l} \\ \\ = \text{area less sector} \\ \\ = \text{area sought} \end{array}$$

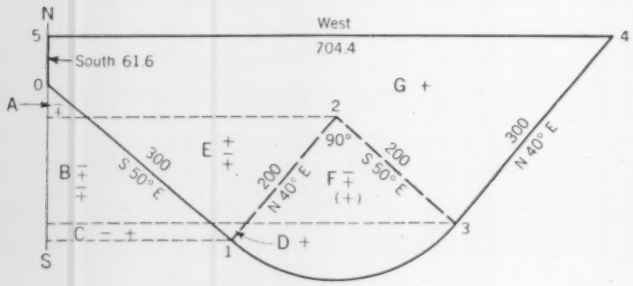


FIG. 2. CURVE SECTOR (above) is entirely within plot. Area computations are given in table above.

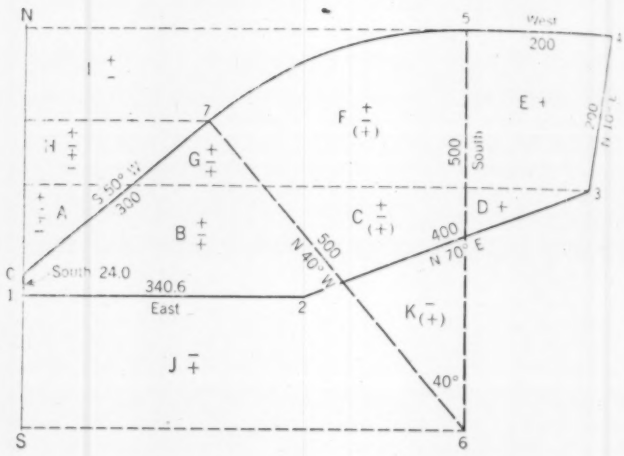


FIG. 3. CURVE SECTOR (at right) is partly inside and partly outside of plot. Area computations are given in table below.

Course	Dist.	Bearing	Latitude N	Latitude S	Departure E	Departure W	DMD	N. Prod. +	S. Prod. −	Half Areas ± A	B	C	D	E	F	G	H	I	J	K
0–1	24.0	South		24.0																
1–2	340.6	East			340.6		340.6													
2–3	400	N 70° E	136.8		375.9		1057.1	144,611		+	+	+	+							
3–4	200	N 10° E	197.0		34.7		1467.7	289,137						+	+	+	+	+		
4–5	200	West				200.0	1302.4													
5–6	500	South		500.0			1102.4		551,200	−	−	−			−	−	−	−	−	−
6–7	500	N 40° W	383.0			321.4	781.0	299,123		+	+					+	+		+	
7–0	300	S 50° W		192.8		229.8	229.8		44,305	−							−			
			716.8	716.8	751.2	751.2		732,871	595,505	/	+	/	+	+	/	+	/	/	/	−

$$\text{Area of sector} = \frac{\Delta \pi R^2}{360} = \frac{\pi R^2}{9} = \begin{array}{r} 595{,}505 \\ 2\overline{)137{,}366} \\ 68{,}683 \\ 87\ 267 \\ \hline 155{,}950 \end{array} \begin{array}{l} \\ \\ = \text{area less sector} \\ \\ = \text{area sought} \end{array}$$

In Fig. 3 we have the situation where the sector crosses our plot, its center being well outside, but part of its area being within. Following around the perimeter as before, we find that sub-areas C and F cancel out but sub-area K stays with us as a negative area. Therefore, if we add the area of the sector we bring C and F back in and cancel out K.

Although this system requires the adding of two courses (the radii) to the perimeter traversed and the simple computation of the sector area, it saves the labor and time of computing chords and segments and will be found simpler and faster than other methods and just as accurate.

In this system, one needs only to remember to:

1. Subtract the sector when it lies entirely outside the plot.
2. Add the sector when it lies entirely within or partly within and partly without the plot.

Another way of stating this principle is, subtract the sector when the curve is concave away from the plot and add when the curve is concave toward the plot.

...THE READERS Write

Federal Control of Pollution-Abatement Programs Opposed

DEAR SIR: The following comments are offered in reference to the attitude and objectives of the ASCE toward federal control of pollution, as set forth on page 56 of the June issue of CIVIL ENGINEERING.

My comments are based on experience gained through association with a state agency, which was established primarily to deal with pollution-abatement problems and which has had the longest record of continuous operation in the country. Many pollution problems, particularly those resulting from the discharge of water-borne industrial wastes, have little or no effect upon the public health. The work of the State Water Commission is, therefore, concerned largely with the broad aspects of pollution abatement as it affects conservation, economic values, and general welfare.

The disapproval by the ASCE Board of Direction of "the provisions of Sec. 2(*d*) (S. 418) which makes it mandatory to bring federal suits for abatement upon request of the Surgeon General" is highly commendable for several reasons:

1. If a state agency is attempting to carry out an abatement program that it considers reasonable and equitable, confusion and delay will result from federal interference. Furthermore, the state agency might consider federal action unreasonable and could not sincerely prosecute such a suit.

2. It is difficult to visualize any federal legal machinery that could be set up without confusion, unwarranted expense, delay, and harm to the program.

3. If a state or interstate program is a good, reasonable, and equitable one, then any federal activity in the matter would be of no value and would merely involve duplication of effort and expense.

4. There is substantial foundation for opposing federal control on the grounds that states actively engaged in abatement work are penalized, through taxation, to support programs in states negligent in this respect.

It is a debatable question as to how great a value could actually be placed upon assistance the federal government might give to state agencies in the formation of programs and in the correlation of research information. Much information on pollution abatement is now available through trade and technical publications, associations, societies, private organizations, and other public and private agencies, and this information can be obtained at little expense. It is available to anyone who is sufficiently interested in obtaining and applying it, and new information is being released almost constantly without the assistance of any federal agency. It is safe to conclude that there are not numerous instances of pollution-abatement programs suffering from lack of information.

I heartily concur with the attitude that the ASCE Board of Direction has taken toward federal control over many activities which are wholly unsuited to federal action and which are ill-conceived and intrusive.

WILLIAM S. WISE, M. ASCE
Chief Engineer, Connecticut State Water Commission
Hartford, Conn.

Says Engineers Not in Position to Bargain

DEAR SIR: The letter by Sidney Weniger on engineering salaries, in the June issue of CIVIL ENGINEERING, was most interesting. His statement, "I felt then, as I do now, that if engineers individually would exercise self-restraint and refrain from accepting salaries not commensurate with their professional education and ability, it would shortly end situations—and there are many of them—where engineers are paid less than men they directly or indirectly supervise," touches on a serious flaw in the average person's logic.

Mr. Weniger must have been quite fortunate in never having had to look for a job. If he had had that experience, he would realize that he is putting the cart before the horse. It was not so long ago that engineers were competing for jobs in an employer's market, and were offered salaries "not commensurate with their professional education and ability." The employer who inserts an ad, such as that quoted by Mr. Weniger, is the person who needs advice on the professional standards we are trying to establish. The young engineer particularly, who has little experience and few acquaintances in the profession, must accept whatever salary he can get. He is not in a position to bargain.

In all fairness, I must say that, in general, those businesses engaged purely in the practice of engineering are more open-handed with salaries than those in which the engineering department is but a necessary evil.

The matter of receiving wages lower than those paid to labor may indicate not that labor is overpaid, but that the engineering profession has put too small an evaluation on its services as compared to those rendered by the construction industry.

W. T. HOOPER, JR., Jun. ASCE
Asst. Prof., Civil Engineering
Northwestern University
Evanston, Ill.

Calls Proposed Increase in ASCE Dues a Must

DEAR SIR: By all means let us increase the dues! Like the next member, who is having a hard time making ends meet these days, I do not want more expenses unless they are a "must." In my opinion this increase in dues is a must!

President Hastings' folder, entitled "Purely Technical or Both Professional and Technical—That's the Question," very admirably states the case. It is not a question of "do we want higher dues?" but "do we want to maintain and advance the Society in its present high plane?"

I say let's not go back to the horse and buggy days, but go forward toward full maturity. Let's advance in stature, rather than decline to the childhood we once lived.

I appeal to the corporate members to vote! This is more than a privilege; it is an obligation. Corporate members are too lazy to mark a ballot and return it to the Secretary. There is no need to go into statistics to prove the case. We all have noted the small percentage of corporate members who take the trouble to vote. Give up five minutes of sleeping

time (that is less than a dollar's worth) and voice your decision on each ballot you receive.

In seeking to become a corporate member, what is the Junior's incentive? At the present time, his incentives are prestige, the right to vote and take office, and reaching the age limit of 35. I have been told that the average age of transfer from Junior to corporate membership is about 30. This means that either prestige, or the right to vote and take office has been the main incentive.

In my own case, I became an Associate Member for the right to vote. Prestige meant less to me, and the right to take office did not even enter my mind. My chief incentive was this right to vote. I was receiving ASCE publications, attending the meetings, enjoying association with successful engineers—all for $10 a year. If, in addition, I had had the right to vote, I would not have paid an additional $10 a year for prestige and the right to take office. No, my sole incentive would then have been reaching the age limit of 35, and I would have waited until that time before making application for transfer. Furthermore, I am willing to bet that most Juniors, if given the right to vote, will wait until the age-limit incentive before becoming corporate members.

Rather than give the Junior the right to vote and hence lose this incentive, I would prefer to see a merger of Members and Associate Members into one group, "Corporate Members," or just "Members," and retain the "Juniors" as is. Then the admission requirements of "Members" could be revised to that of our present "Associate Members" or even stiffer. In my opinion, the Junior would then have a real incentive to seek full membership and the Associate Member would no longer be required to explain constantly what is meant by "Associate."

Here are my parting shots!

1. Let's increase the dues!
2. Let's wake up and vote!
3. Let's *not* give the Junior the vote, but go deeper into the problem and come out with reorganization!

EARL C. MESERVE, Assoc. M. ASCE

Little Rock, Ark.

[EDITOR'S NOTE: The Board of Direction has the reorganization of membership grades under current study, as indicated by the statement and questionnaire on the subject in the July issue. Since Juniors now constitute about one-third of the entire ASCE membership, the Board of Direction believes that Juniors are entitled to vote later on any questions of change in grades or qualifications, including the right of full corporate membership and that of holding office. The proposed amendment to enfranchise Juniors, if approved by the present corporate members, will then give Juniors a voice in deciding if the membership-pattern should be reorganized and, if so, how.]

Says ASCE Should Broaden Professional Objectives

DEAR SIR: The small brochure, "That's the Question," enclosed with a communication from ASCE Executive Secretary William N. Carey concerning nominations for Vice-President and Directors has been carefully read.

It is my belief that the Society should broaden its objective toward attainment of the professional improvement of its members beyond what it is doing at the present time.

I have been a member of the Society for years, and I feel that while the technical side of our profession is splendidly covered, the professional and public aspects of engineering have been signally neglected.

CARTER JENKINS, M. ASCE

Springfield, Ill.

Cites Dangers in "Waving the Rod"

DEAR SIR: I was interested in the article on "waving the rod" by H. S. Rappleye in the April issue. Waving the rod always has been, and still is, advocated by textbooks, college professors, and surveyors. Where an error occurs, it is attributed to "just one of those things" or to the personal equation and then forgotten.

About twenty years ago I investigated some level results and discovered for myself that the trouble was due to the waving of the rod. My conclusions were published in *Engineering News-Record* at the time. They were similar to Mr. Rappleye's article without the details.

It is quite possible that others made the same discovery prior to publication of my article on the subject. I think that articles about new discoveries (that may not be new) should mention previous literature on the subject. Mr. Rappleye's article explains the error of waving the rod very clearly, and certainly should help rod readers to avoid such errors.

GEORGE GOODWIN
Construction Engineer

Elizabeth, N.J.

Use of Girder-Type Bridge Sections Affirmed

TO THE EDITOR: In order to keep the record straight, I feel it necessary to reply to the discussion by F. B. Farquharson in the February 1947 issue of CIVIL ENGINEERING.

The issue is very simple. I stated (CIVIL ENGINEERING, October 1946) that there are no new or mysterious aerodynamic virtues contributed by the use of trusses instead of girders in suspension bridge cross sections and that, in general, any truss cross section is aerodynamically equivalent to a girder section of determinable shallower depth. Professor Farquharson challenges that statement, but in his challenge he adds to my comparison the qualifying phrase "in the range of practical d/b ratios." His addition of that qualifying phrase changes the issue.

In the case of girder sections, whether of H-type, deck type, or other form, a convenient scientific classification is available in the section-ratio d/b. A flat plate is a girder section of zero d/b. The George Washington Bridge section is a girder section of very low d/b. The section-ratio d/b identifies the section and determines the aerodynamic characteristics.

In the case of truss sections, such simple, direct method of identification is lacking. Instead, I use the equivalent section-ratio of a corresponding girder section. The equivalent section-ratio depends upon the percentage of solid area in the elevation of the truss. For very light or open trusses, the equivalent girder section is very shallow, approaching the limiting case of a flat plate. Any improvement in characteristics is not due to the truss members acting as "spoilers" (of hypothetical vortex action), but is merely due to the removal of shielding by reducing the solid vertical area. Any advantages of a truss section are the same as the advantages of a shallow girder section, whether or not such shallow girder section is considered of "practical form." The fundamental unifying principle is basic.

Accordingly truss sections are not a separate genus, obeying different laws. The same theory, the same formulas, and the same basic model tests apply. Both truss and girder sections have a common limiting case—the flat plate.

It is, of course, easier to secure aerodynamic stability by using light trusses than by using solid girders of the usual forms and proportions. No elaborate model tests are required to make that discovery. But the mere adoption of trusses is not an adequate solution. It does not assure safety. And the blanket

(*Continued on page 80*)

SOCIETY NEWS

EDITORIAL:

The President's Message

(Following his formal Annual Address (see page 16), President E. M. Hastings made some informal remarks at the Summer Convention in Duluth, July 16. In part, they are as follows.)

IN MY FORMAL ADDRESS I touched but lightly on the need for our membership to provide the financial backing, as well as the leadership within our Society, so that its professional activities will be effective. As you might expect, my informal remarks will be about the two proposed Constitutional Amendments, since those amendments are so closely associated with the subject of financial backing.

I feel even more strongly now than I did upon assuming the ASCE presidency last January, that the very life and growth of our Society hinge upon the decisions which the corporate members will make this fall on the questions of enfranchising Juniors and increasing dues.

I desire to express my gratitude to the members of the Board of Direction, who have given so generously of their time to attend Local Section meetings throughout the country to explain the need for adoption of the amendments. Together with CIVIL ENGINEERING and the headquarters staff, they have done a magnificent job of informing the members of the importance of these issues, as well as in providing the membership with details of the Society's financial problems. The decision on these issues, by ballot of the corporate membership, will determine whether the Society shall recede to the purely technical organization it was during its first 70-odd years, or proceed along the path of professionalism it began to follow but recently.

And I am just as optimistic today as I was in January when I said, at the Annual Meeting: "I am confident that today's members of our profession will be no less farsighted than earlier generations of Society members, who not only provided us with an ever-growing and ever-more-useful Society, but also created the modest reserves upon which we now are drawing pending the operation of our democratic process of constitutional amendment to provide dues with which we can pay our own way. I am confident that our professional pride today will be no less than that of the men we succeed in the profession they created and enhanced, and that we too shall do our duty by future generations of civil engineers."

The need today for leadership by engineers is great. Do-gooders, wishful thinkers, and overly-nationalistic politicians for much too long have crowded the proponents of common sense almost off the national and international stage. Confusion has been added to confusion. It is high time this nation and the world had the advantages which can be found in the non-political, unbiased, factual and analytical thinking of which the engineer is capable. Perhaps the best place for engineers to exercise leadership is through their own professional Society.

I urge upon our corporate membership the advisability of retaining the leadership for which the ASCE has become so favorably known in the engineering profession. I urge them to meditate carefully on their obligations to the younger men of the civil engineering profession, some 7,000 of them constituting approximately one-third of our membership. I urge our corporate members to be aware of the interrelationship between the amendment for giving the vote to the rapidly-growing Junior membership and the amendment providing for an increase in dues, to provide funds to carry on the professional and economic activities of their Society, in which, of course, these younger men have a major interest.

In short, I urge the corporate membership to use their ballots when they get them and to vote "yes" on BOTH Constitutional Amendments, that we may continue to be a growing, virile and active *professional*, as well as a technical, Society of Civil Engineers.

Survey of Engineers Is Approved by ASCE Board

SO THAT PLANS can be made for a more efficient use of scientific manpower in time of national emergency, the American Society of Civil Engineers will make a survey of its 22,000 members, in cooperation with the War and other federal departments, to compile data disclosing how engineers can be most useful to the nation in such an emergency.

A questionnaire, as approved by the Board of Direction at the concluding session of its two-day meeting preceding the Annual Convention of the Society in Duluth will seek data on education, civilian experience in military departments or war agencies during World War II, employment status, occupational status, utilization of engineering experience in civilian wartime employment, as well as in military service, and other factors designed to assist in cataloging engineers for potential national emergency service.

At the same meeting, the Board instructed Executive Secretary William N. Carey to "take all proper action available to the Society to secure the passage of legislation providing for universal military training, which is in substantial accord with the recommendation of President Truman's Special Committee on Universal Training." Action by the Board was at the request of the War Department and followed several months of discussion.

Study of Joint Strength Sponsored by Foundation

STUDY OF THE strength and behavior of riveted and bolted joints is one of the latest projects to be sponsored by the Engineering Foundation. The research is being carried on at the University of Illinois and at Northwestern University under the direction of a research council whose members represent the various interests concerned.

Investigation will be made into the static and fatigue strength of joints in tension members with various rivet patterns; the static and fatigue strength of structural joints fabricated with hot-driven rivets, cold-driven rivets, carbon-steel bolts and alloy-steel bolts, and the relation between the properties of metals and the behavior of structural members.

Ballot on Dues Increase, Vote for Juniors Authorized at ASCE Summer Convention

CONSTITUTIONAL AMENDMENTS enfranchising Juniors and increasing Society dues will be voted on this fall as a result of action taken at the business meeting of the American Society of Civil Engineers' Summer Convention in Duluth, Minn., July 16. Both amendments will be sent to ballot as a result of the action by the Corporate Members in attendance at the Convention business session.

Dues of all Corporate Members and Affiliates will be increased $5.00 per year if the dues amendment is adopted when it goes to ballot. From the floor of the Convention an amendment to the proposed constitutional amendment regarding dues of Juniors was offered and adopted. This change was in accordance with conclusions reached by the Board of Direction at the Spring Meeting in Phoenix, Ariz., of which the Corporate Members were informed in a statement accompanying the notice sent them to the effect that the two proposed amendments would be considered at the Summer Convention business meeting. The change provides that dues for Juniors up to the age of 32 be set at $12.50 per year.

This Duluth Convention change will result in no increase for the approximately 600 Juniors in the New York City area; in fact their dues rates will be reduced $2.50 so that all Juniors everywhere will be placed on a common dues level. Juniors in the Metropolitan Section now pay $5.00 per year more than Juniors in the other areas, just as the other grades of members in the Metropolitan area pay $5.00 a year more than members elsewhere. New York members, except the Juniors, will continue to pay $5.00 a year more dues than Corporate Members and Affiliates living outside the New York Metropolitan area if the Society ballots favorably on the dues amendment proposal.

Appreciation Due Local Committee

Words of appreciation are due the local meeting committee, headed by Gordon H. Butler, for an excellent convention. By the close of the meeting visitors had acquired a close acquaintance with Duluth and its outstanding points of interest—and above all with its civil engineers and their wives. The meeting attracted about 350 members from all over the United States.

The program combined technical sessions with excursions and entertainment. Activities were formally opened on Wednesday morning, July 16, by President A. C. Josephs of the host Section. Welcome to the city was extended by Mayor George W. Johnson, who capably expressed his understanding and appreciation of the activities of civil engineers and their society. Following his response to the Mayor, President E. M. Hastings delivered his Annual Address (see page 16), calling upon engineers to emerge from "the narrow confines of a purely technical life and a purely technical thinking," and to assume leadership in national and international affairs by proproviding "the nonpolitical, unbiased, factual and analytical thinking of which the engineer is capable."

TALK ON DULUTH AND ITS HISTORY by Margaret Culkin Banning, well-known author and speaker, featured ASCE dinner meeting, held at Hotel Duluth on July 16. Native of Duluth, Mrs. Banning has distinction of being one of few women to address an ASCE meeting.

Two other addresses were presented at the Wednesday morning general session, both dealing with the resources of the state of Minnesota. "A long future" for the mining industry in Minnesota was predicted by Elting H. Comstock, formerly dean of the school of mines at the University of Minnesota. Mr. Comstock countered apprehension of war deflation of the famed Mesabi deposit of iron ore with facts and figures on ore reserves and a prediction that concentration methods will be developed to permit utilization of deposits of low-grade ores.

Depletion of timber reserves was discussed later in the program by Galen W. Pike, Forest Supervisor of the Superior National Forest. "Recent surveys," he cited, "show that as a nation we are seriously overcutting our saw timber budget, and that more than half of our commercial forest lands are being cut without any pretense of forest management." Formerly a large exporter of timber, Minnesota now imports two-thirds of her lumber requirements, he pointed out.

Intensive management of forest lands was advocated, although Mr. Pike warned that even if this were possible, "it would be 30 to 50 years before such abused lands could contribute much toward balancing the timber budget."

Membership Luncheons

Special luncheons for the men attending the convention were provided throughout the three days. The first two were held in the Hotel Duluth ballroom and the third in Hibbing on the route of the excursion to the Hull-Rust mine. On Wednesday, when ASCE members were joined by members of the Duluth Engineers Club, the Association of Professional Engineers, and the Northern Minnesota Engineers Society, the speaker was S. L. Stolte, past-president of the Minnesota Federation of Engineering Societies. His topic was "Professionalism in Engineering."

Utilization of peat in the production of gas and power was called a matter of "first importance to the national security" by the speaker at the Thursday luncheon, Robert L. Fitzgerald, vice-president and general manager of the Duluth Steam Corp. An account of Mr. Fitzgerald's address appears on page 24.

Seven Divisions Meet

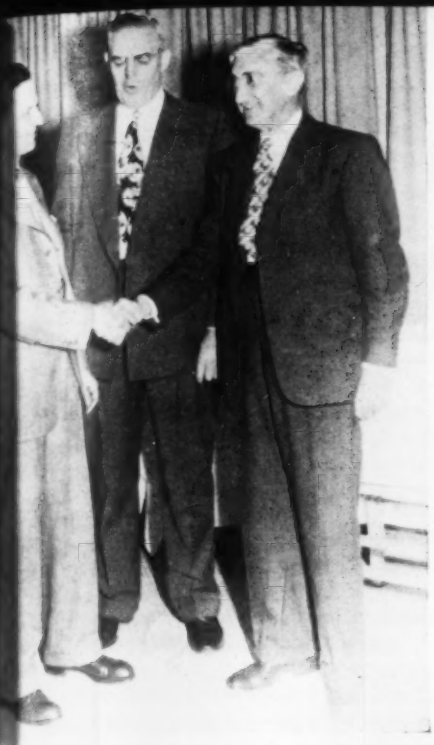
Throughout this Summer Convention continuous attention was given to technical engineering problems. Seven of the Technical Divisions of ASCE scheduled sessions. These produced a wealth of information and separate accounts of each Division's activities are given on pages 17–24.

As part of the Society's public relations program, officers and Directors of ASCE were invited to address Duluth civic and luncheon clubs during the week of the convention. In addition, a larger audience was reached by the radio programs featuring ASCE members and their activities, as well as disseminating information as to the role played by civil engineers in society.

Open-Pit Mines Visited

Buses set forth Friday morning laden with sight-seers to visit the world's largest open-pit iron-ore mine at Hibbing, Minn. This Hull-Rust mine has produced a total of 361,000,000 tons of ore since it was opened in 1896 and is still going strong.

Previous opportunities were offered to bring engineers and their wives together



A. C. JOSEPHS, PRESIDENT of Duluth Section (left), welcomes ASCE President E. M. Hastings at opening session of ASCE Summer Convention, as Executive Secretary William N. Carey looks on.

MEMBERS AND GUESTS (upper right) register at Hotel Duluth for Annual Convention, July 16 to 18. Total registration for three-day meeting is about 350.

MEMBERS OF LADIES COMMITTEE (left) Duluth Convention (seated, left to right) are: Mrs. S. B. Shepard, Mrs. B. L. Larsen, Mrs. H. E. Farnam, general chairman, Mrs. Ralph Palmer, and Mrs. George W. Deibler. Standing, left to right: Miss Regina Tarr, Mrs. Roland Buck, Mrs. Leland Clapper, Mrs. A. C. Giesecke, Mrs. A. C. Josephs, Mrs. Gordon Butler, Mrs. E. E. Adams, and Mrs. Arthur Tews.

GENERAL PROGRAM COMMITTEE for Annual Convention (above) consists of (left to right, seated): E. E. Adams, Gordon Butler, general chairman, George W. Diebler, T. F. McGilvray, and A. C. Giesecke. Standing, left to right are: John Fredin, John Pickles, Ralph Palmer, S. W. Tarr, and H. E. Farnam.

LOCAL SECTION CONFERENCE—Hotel Duluth, July 14 and 15—is attended by (seated, left to right): J. W. Frazier, Topeka, Kansas Section; C. W. Yoder, Milwaukee, Wisconsin Section; H. S. Miller, St. Louis, St. Louis Section; Col. Harland Woods, Buffalo, N.Y., Board Contact Member; Rogert Angas, Jacksonville, Fla., chairman, Committee on Local Sections; A. C. Josephs, president, Duluth Section; Sterling Green, Los Angeles, Los Angeles Section; S. J. Callahan, Kansas City, Kansas City Section; L. O. Stewart, Ames, Iowa, Iowa Section; and N. H. Gundrum, Springfield, Ill., Central Illinois Section. Standing, left to right: Don P. Reynolds, New York, Assistant to Secretary; W. J. Schulten, Jefferson City, Mo., Mid-Missouri Section; S. W. Tarr, Duluth, Duluth Section; L. S. Finch, Indianapolis, Ind., Indiana Section; A. L. R. Sanders, Chicago, Illinois Section; and G. M. Wood, Rock Island, Ill., Tri-City Section.

at the carefully planned dinners on Wednesday and Thursday evenings. On the first evening, an informative and entertaining address was given by Margaret Culkin Banning, followed by motion pictures and dancing. Thursday's gathering was entertained by the Duluth Symphony Orchestra.

Local Committee Commended

Special note should be made of the fact that the Local Section which sponsored this Summer Convention, and did such a grand job on arrangements, is the Society's smallest Section—numbering only 19 members. It was apparent that this group made up in spirit and energy for its lack of numbers.

ASCE Men Join Chamber in City Planning Study

SEVERAL ASCE MEMBERS will play prominent roles in a Businessmen's Conference on Urban Problems, which the Chamber of Commerce of the United States has called for Washington, D.C., September 11 and 12.

Subjects long under study by civil engineers, notably those in the ASCE City Planning Division, will be discussed, with businessmen exchanging ideas with the engineers and city, state, and federal officials in attendance.

City planners, who long have held that cooperation of the business interests of cities is essential, particularly in connection with traffic routing and parking regulations, are especially interested in the Chamber's meeting notice which reads, in part:

"While it is recognized that municipal officials have the final decision in these matters, the fact remains that the business element of each community can perform a valuable service by participating in the consideration of various proposals, by helping to mobilize public opinion behind accepted solutions, and by helping to translate plans into definite accomplishments."

Subjects to be covered include city planning in relation to community development, traffic congestion, off-street parking, and rebuilding blighted areas.

Among the ASCE members invited are: Thomas H. MacDonald, Hon. M. ASCE, commissioner, Public Roads Administration, Washington, D.C.; George M. Shepard, M. ASCE, city engineer, St. Paul, Minn.; Frank T. Sheets, M. ASCE, president, Portland Cement Association, Chicago; G. Donald Kennedy, M. ASCE, vice-president, Automotive Safety Foundation, Washington, D.C.; P. Y. K. Howat, M. ASCE, chairman, District of Columbia Parking Authority, Washington, D.C.; and Harold F. Hammond, Assoc. M. ASCE, assistant manager, Transportation and Communication Department, Chamber of Commerce of the United States, Washington, D.C.

Members Named for EJC Consultative Committee

PRESIDENTS AND past-presidents of the five national engineering societies that are constituents of Engineers Joint Council comprise the Consultative Committee named by EJC to advise with the U.S. Department of State (see CIVIL ENGINEERING, July 1947, page 51).

Those who will serve on the committee, formulated in response to a request from William Benton, Assistant Secretary of State, are E. M. Hastings, President, ASCE; Clyde E. Williams, president, AIMME; Dr. William E. Wickenden, past-president, AIEE; D. Robert Yarnall, past-president, ASME; and James G. Vail, past-president, AIChE.

Volume III of ASCE Transactions Issued

DIFFICULTIES IN CONNECTION with purchase of paper having been overcome, the 1946 volume of TRANSACTIONS, No. 111, has been issued, marking another milestone in the permanent recording of technical advancement in the field of civil engineering. Volumes in paper and cloth binding have been sent out, while the half-morocco bindings are in the final stages of manufacture and will be distributed late this summer. Promises for the future indicate that lack of paper will not delay the succeeding Vol. 112, now in the course of preparation.

Volume 111 contains a total of 1,664 pages, including some 1,340 pages of technical papers and discussions, 60 pages of reports and 200 pages of memoirs. Complete indexes make up the balance of the total number of pages.

Almost 60 percent of the technical material is in the form of discussion. Stated another way, there are approximately one and one-half pages of constructive comment for every page of original paper, providing an intimate scrutiny for the principles and practices of engineering which have been advanced. These verifications and corrections constitute a valuable and unique attribute of the ASCE TRANSACTIONS.

Some 200 members contributed to the memoirs of deceased members. Not to be forgotten, although in the background, were another 200 members who gave impartial confidential advice on the technical merits of the papers, both those published and those declined.

Engineering Hall Renamed for Dean Anson Marston

ENGINEERING HALL, HEADQUARTERS of the division of engineering at Iowa State College, has been renamed Marston Hall in honor of Dean Emeritus Anson Marston, Past-President and Honorary Member, ASCE, who headed the division for 28 years. Dean Marston came to Iowa State in 1892 as professor of civil engineering and became the first dean and first director of the Engineering Experiment Station in 1904.

As chairman of the Iowa Highway Commission, he was largely responsible for the development of the present Iowa highway system. He retired from administrative duties in 1932 at the age of 68 to teach and continue research.

Boris Bakhmeteff, Hon. M., Receives French Award

FOR HIS OUTSTANDING contributions in the field of hydraulics, Boris A. Bakhmeteff, Hon. M. ASCE, professor of hydraulics at Columbia University, was recently honored by the Ministry of Education of France with the Medal d'Officier d'Academie et de l'Instruction Publique, one of the highest scientific awards of France. Presentation of the medal was made by the Consul General of France at a special ceremony held in the office of the Cultural Counselor to the French Embassy, in New York City, on June 12.

Dr. Bakhmeteff has been active in the Hydraulics Division of the ASCE and, at present, is chairman of its Committee on Hydraulic Research. He recently served as chairman of the EJC Panel for promoting the interests of engineers in a National Science Foundation and, in recent months, was in the Canal Zone as a member of a board of review sent by the government to study possible Canal alterations.

Society Appointments

CHARLES GILMAN and MEYER HIRSCHTHAL, Members ASCE, have been appointed to represent the ASCE on the American Society for Testing Materials Committee A1 on ASTM Standards for Portland Cement, which is being reactivated after a period of wartime inactivity.

W. W. HORNER, Past-President ASCE, has been appointed chairman of the Fact Finding Committee on U.S. Bureau of Reclamation. Other ASCE members on the committee are J. C. STEVENS, Past-President ASCE, and RAYMOND A. HILL, M. ASCE.

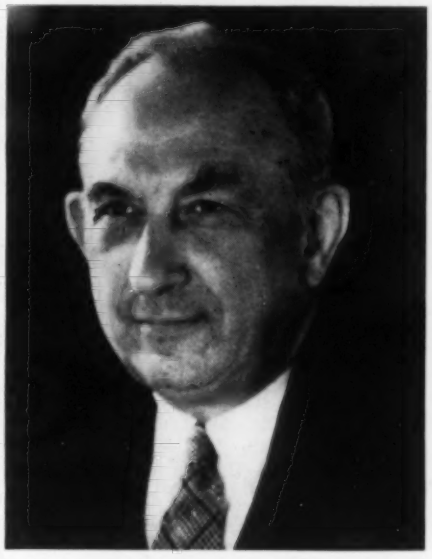
Richard E. Dougherty Is Nominated for President

RICHARD ERWIN DOUGHERTY, New York City, vice-president of improvements and development for the New York Central System, was nominated as the 1948 President of the ASCE by the Board of Direction at its summer meeting in Duluth. A full member of the Society since 1912, Mr. Dougherty served as Director from 1928 to 1930 and as Vice-President in 1944 and 1945.

A native New Yorker, he attended the College of the City of New York three years and Columbia University four years, graduating with the C.E. degree in 1901. While at Columbia, he was made a member of the honorary engineering society, Tau Beta Pi. In 1945 he received the Egleston Medal of the Columbia University Engineering Alumni Association for distinguished engineering achievement. He taught at Columbia in 1901 and 1902, and from 1916 to 1920 was special lecturer at Cooper Union.

Mr. Dougherty has been associated with the New York Central System since 1902, and has been vice-president in charge of improvements and development since 1930. He is also vice-president of 43 of the railroad and real estate subsidiary companies of the organization, and director of 29 subsidiary companies. In 1946 he was elected president of the Lakefront Dock and Terminal Railroad Co., a joint company formed by the New York Central and the Baltimore and Ohio for the construction and operation of a new coal and ore terminal on Lake Erie at Toledo.

During World War II, Mr. Dougherty acted as one of the New York Central's principal contact officers with the Army, Navy, Defense Plant Corp., and other government agencies in locating plants and industries. He also served as principal contact officer with the Transportation Corps of the Army in the organization of four railway battalions of the Military Railway Service, which later served in Africa, Italy, the European Theater, and India. From 1942 to 1945 he was chairman of the New York Central's Research Council for consideration of postwar problems, and at present is chairman of its Executive Research Committee.



R. E. Dougherty, Nominee for President, 1948

Mr. Dougherty's connection with the Society goes back to 1903, when he was elected a Junior. During the time he was on the Society's Board of Direction, he was a member and chairman of the Committee on Division Activities. He has also been on the Executive Committee, the Committee on Honorary Membership, and the Committee on Registration of Engineers. At present he is representing the Society on the administrative bodies of United Engineering Trustees, Inc., and Engineering Foundation.

Railway engineering groups have also claimed much of Mr. Dougherty's attention. Since 1935 he has been chairman of the Grade Crossing Committee of the Association of American Railroads, acting for all the railroads in cooperation with the Public Roads Administration. He is also a member of the Committee for the Study of Transportation, appointed by the Association of American Railroads to consider postwar problems.

Other affiliations include membership in the American Railway Engineers Association, which he has served as director. At present he is chairman of the engineering committee of the Chicago South Side Railway Terminal Committee, appointed to direct investigations and studies for the proposed Chicago union terminal project.

Following the usual election procedure specified by the ASCE Constitution, he will take office at the Society's Annual Meeting in New York in January 1948. A more extensive biography of his career will appear in a later issue of CIVIL ENGINEERING.

NEWS OF LOCAL SECTIONS

Coming Events

Alabama—All-day summer meeting in Mobile, Ala., August 22. Registration at 9 a.m. Swimming, cocktails, and barbecue, to which the ladies are invited, at 5 p.m.

Colorado—Regular meeting at the Oxford Hotel, Denver, September 8, at 6:30 p.m.

Louisiana—Joint meeting with the Louisiana Engineering Society at the St. Charles Hotel, New Orleans, August 11, at 8 p.m.

Sacramento—Regular luncheon meetings at the Elks Club every Tuesday at 12 noon.

South Carolina—Annual summer convention at the Poinsett Hotel, Greenville, S.C., August 8 and 9. This will be a joint meeting with the South Carolina Society of Engineers.

Texas—Meeting of the Dallas Branch at the Adolphus Hotel, Dallas, September 1, at 12:15 p.m.

Scheduled ASCE Meetings

FALL MEETING

Jacksonville, Fla., October 15–17
(Board of Direction meets October 13–14)

ANNUAL MEETING

New York, N.Y., January 21–23
(Board of Direction meets January 19–20)

Recent Activities

BUFFALO

A COMPLETE TOUR of dredging, transporting, and dumping operations of the U.S. Dredge *Taylor* in Buffalo Harbor and Lake Erie constituted a recent joint meeting with the buffalo post of the Society of American Military Engineers. As in past years, the opportunity to observe the regular operations of the Corps of Engineers proved so popular that it was necessary to divide the party into two groups that made the trip on consecutive days.

CLEVELAND

STUDENT CHAPTER MEMBERS from the Case Institute of Technology provided the program at a recent technical meeting of the Section. John de Hamel, president of the Chapter, described the transition from the school's wartime student body to its postwar personnel. He was followed

by a panel of senior-class members of the Chapter, who discussed an engineering inspection trip the class had made to New York. During the evening, it was announced that the Section's prize of Junior membership in the ASCE goes to Franklin Liles, of Ohio Northern University. A similar award is being made to Laurence Archer, of Ohio Northern, by the engineering school there.

CENTRAL ILLINOIS

GUEST OF HONOR and principal speaker at a recent joint meeting with the University of Illinois Student Chapter was Dr. Karl Terzaghi, professor of the practice of civil engineering in the Harvard Graduate School. Dr. Terzaghi, who was recently in India and Egypt as consultant on large dam projects, gave an illustrated talk on engineering aspects of his trip. During the evening, Section awards were presented to two outstanding members of the Student Chapter — Thomas L. Thomas, of the department of civil engineering, and Paul C. Brandt, of the department of architectural engineering.

CENTRAL OHIO

A FAVORABLE PROFESSIONAL environment is necessary if the technical tools of the engineer are to be used to best advantage, ASCE Executive Secretary William N. Carey told the members at a recent dinner meeting. Speaking on the proposed amendments to the constitution, Colonel Carey stressed the present ASCE trend toward professional activities, and discussed the Society's current interest in professional licensing laws, salaries of engineers in public employment, U.S. State Department legislation, and labor legislation to improve the status of the engineer. During the evening, Prof. Robert K. Morris presented Brown Scholarships to four Ohio State University students — Paul M. Churton, Carl M. Edwards, Paul F. Graham, and Lester A. Herr — for "meritorious work." The scholarships, which carry a stipend of $200 each, were established by a group of civil engineering alumni of the university in honor of the late Christopher Newton Brown, for many years connected with the college of engineering at Ohio State.

DAYTON

THE MANUFACTURE OF wrought iron from the early days of the process to present methods and procedures was discussed by Robert E. Allen, engineer for the Univis Lens Co., of Dayton, at a recent luncheon meeting. Mr. Allen showed a motion picture on the subject that has been prepared by the A. M. Byers Co., Pittsburgh manufacturers of wrought iron and steel products.

VISITING ENGINEERS FROM INDIA are guests of Georgia Section at recent outing at Allatoona Dam site. Left to right: Robert Harris, president, Georgia Section; B. R. Manickam, Mysore State, India; Bert Bell and C. P. Lindner, South Atlantic Division, U.S. Engineer Department; K. S. Gangadhara, Mysore State, India; and D. J. DeJarnette, South Atlantic Division, U.S. Engineer Department.

GEORGIA

THE FIRST OF a proposed series of summer field trips took 75 members and guests of the Section to the site of Allatoona Dam on the Etowah River. Following a picnic luncheon and brief social meeting, conducted tours of the $27,000,000 multi-purpose reservoir project were organized under the direction of C. A. Jackson, project manager. The project, which is being constructed for flood control and hydroelectric power, includes a 1,250-ft-long concrete gravity dam and a powerhouse with two generating units of 40,000-kva capacity each. Primary contract for construction of the project is held by National Constructors, Inc., which began work in July 1946 and expects to complete the job by the end of August 1949.

DISTRICT OF COLUMBIA

AN ATTENDANCE OF 376 members and their guests made the June 28 meeting the largest in the history of the Section. The meeting, consisting of an inspection tour of the Washington and Alexandria waterfronts, was held on the *S.S. Robert E. Lee*. A delegation from the U.S. Bureau of Reclamation, headed by Commissioner Michael Strauss, were guests of the Section and discussed various phases of the work of the Bureau. Also called upon to speak, during the course of the afternoon, were Capt. Miles Du Val, of the Navy Civil Engineer Corps; E. Lawrence Chandler, Eastern Representative of the ASCE; and Harold Kemp, director of sanitary engineering for the District of Columbia. The latter described the operation of the sewage treatment plant at Blue Plains, Md., which the group viewed on the return trip up the Potomac. Col. Byron Bird, of the Washington District Engineer's office, equipped with a microphone and a set of loudspeakers, acted as master of ceremonies and kept the group informed of points of interest. Colonel Bird also described present plans for the further development of the Potomac. The committee in charge of arrangements was headed by Harold H. Marsh.

FLORIDA

A FOUR-YEAR PERIOD of higher education is not enough for the student specializing in engineering, C. D. Williams, head of the civil engineering department at the University of Florida, told members of the Section at a recent meeting. Speaking on the subject of engineering education, Professor Williams advocated a longer period of training as the only solution to the problem of providing the student with a better foundation for his profession. A symposium on stream pollution in Florida comprised the program at a later meeting, held jointly with the Jacksonville post of the Society of American Military Engineers and the Engineering Professions Club of Jacksonville. Speakers were David Lee, Chesley Garland, and John Miller, of the Florida State Board of Health, and Robert Angas, Jacksonville consultant.

INTERMOUNTAIN

LOCAL PROBLEMS OF irrigation, drainage and water supply were discussed at a regular dinner meeting. Speakers included George D. Clyde, dean of engineering and mechanic arts at Utah State Agricultural College, and Prof. C. H. Milligan, of Utah State. The Student Chapter winner of Junior membership in the Society was announced as Austin Bert Caseman, of Utah State. New sewerage developments in Utah were described at another recent meeting by Lynn Thatcher, state sanitary engineer. At the same session Professor Milligan headed a discussion of Society affairs, as outlined in the current CIVIL ENGINEERING.

IOWA

WORK OF THE State Building Code Committee of Iowa, which led to legislative passage of a recent enabling act authorizing preparation of a State Building Code, was explained by Frank Kerekes, chairman of the committee and newly appointed assistant dean of engineering at Iowa State College, at the May meeting. The meeting — held in Iowa City on the 12th—was a joint session with the Iowa Engineering Society and the Iowa City Engineers Club.

ILLINOIS

FOUR AVIATION EXPERTS led a forum on the subject "Will Chicago Be the Air Hub of the World?" at the May meeting of the Section. Taking part in the discussion, which ranged from pattern and terminal facilities to means of financing airports, were Ralph H. Burke, airport consultant for the City of Chicago; Robert Dewey, director of aeronautics for the State of Illinois; W. A. Patterson, president United Air Lines; and Lane Wilcox, superintendent of CAA's Airport Branch. Certificates of Junior membership in the Society were awarded to the following outstanding civil engineering seniors: Ernest J. Vlad, Illinois Institute of Technology; Robert C. Kendall, Purdue University; John August Schultz, Jr., Northwestern Technological Institute; Charles G. Weibel, Rose Polytechnic Institute; and James F. Halsey, University of Illinois.

LEHIGH VALLEY

ENGINEERS SHOULD DIVERT more of their energy to human affairs, ASCE President E. M. Hastings told members of the Lehigh Valley Section at their recent silver jubilee meeting. In Mr. Hastings' opinion, engineers should branch out into other fields in order to give the world the benefit of their training. "Pay attention to getting along with your fellowmen and don't leave government solely up to politicians," he urged. Other speakers were Prof. W. S. Lohr, of Lafayette College, a charter member and past-president, who reviewed the Section's 25-year history; James W. Pastorius and V. W. Anckaitis, president and vice-president of the Section; and Jonathan Jones, chief engineer of the Bethlehem Steel Co. Prof. M. O. Fuller, of Lehigh University, was presented with a gold wrist watch in appreciation of his lengthy service as secretary-treasurer of the Section during its entire period of existence.

MID-MISSOURI

GREAT STRIDES HAVE been made of recent years in the eradication of weeds by means of chemicals, according to H. D. Crain, of the Dow Chemical Co. Addressing a joint luncheon meeting of the Section and the Jefferson City Engineers Club on June 27, Mr. Crain reviewed the history of attempts to find chemicals that would kill harmful weeds and insects without injury to beneficial plant and insect life. A movie showing the type of equipment needed for using chemical controls in agriculture and on railroads and highways concluded the program.

MID-SOUTH

INCREASED ACTIVITIES OF the Society during the past few years were outlined by ASCE Assistant Secretary James E. Jagger at a dinner meeting of the Section, held in Memphis on June 16. Discussing the proposed amendments to the constitution, Mr. Jagger pointed out that this expansion of Society interests and activities has naturally increased expenditures, and stressed the necessity of raising dues. A general discussion followed his talk. On the same trip South, Mr. Jagger also addressed a luncheon meeting at Little Rock, Ark., which was attended by 30 members of the Mid-South Section living there.

MONTANA

MORE THAN 6,000 oil and gas wells have been drilled in Montana and more than 160 million barrels of oil have been produced since the discovery of oil in the state, Duane Cagle, speaker at the June meeting, stated. Mr. Cagle, who is chief chemist for the Home Oil and Refining Co., of Great Falls, Mont., discussed modern refining processes. Installation of the Dubbs cracking process enables present-day refiners to produce the high octane gasoline necessary to the operation of modern motors. Formerly, Mr. Cagle said, only two types of gasoline were obtainable from the crude oil by a straight distillation process, a low-grade gasoline and kerosene, the balance of the crude oil being thrown away as a useless residue.

POSTER ADVERTISING ANNUAL Field Day of Los Angeles Section, held on June 18, attracted attendance of 118 for an afternoon of softball, golf, and other sport and entertainment features. Dinner meeting in evening concluded program.

SYRACUSE SECTION OFFICERS are photographed with ASCE Director Harland Woods at recent meeting at Syracuse Museum of Fine Arts. Left to right: Richard G. Coulter secretary-treasurer; T. W. Hunt, retiring president; Colonel Woods; and E. M. Graf, vice-president. New president, Donald E. Stearns, was out of town.

SYRACUSE

ASCE DIRECTOR HARLAND C. WOODS, of Buffalo, attended a recent meeting of the Syracuse Section and led a general discussion of current Society activities. At the meeting, which was held in the Syracuse Museum of Fine Arts, Donald E. Stearns was elected president and Emil Graf and Earl F. O'Brien, vice-presidents. Richard G. Coulter continues as secretary-treasurer.

OREGON

MEMBERS OF THE Oregon Section were guests of the officers at the Tillamook Naval Air Base for a recent picnic luncheon and inspection tour of the base. Of special interest to the group were the timber hangars, built for the purpose of storing lighter-than-air craft. Talks by the officers stationed at the base and former ASCE Director John W. Cunningham comprised the technical program. The latter described the design and construction of the station, for which his firm was primarily responsible.

SACRAMENTO

MAXIMUM REAL ESTATE values have been reached in California, according to Frank C. Balfour, chief right-of-way agent for the California Division of Highways. Addressing a recent luncheon meeting on the subject of "Land Acquisition Problems," Mr. Balfour expressed the opinion that in the next three-year period a gradual decline in values will take place, with a leveling off about 50 percent above 1940 prices. At another of the June luncheons members of the Section heard Noel Gray, assistant attorney for the War Assets Administration regional office in San Francisco, speak on the disposal of war surpluses and its effect on the average citizen.

PITTSBURGH

ENGINEERING PROJECTS OF interest in Greenville, Pa., and its vicinity were the objective of an all-day inspection trip made by members of the Pittsburgh Section in June. Projects viewed included the railroad shops, centralized traffic control system and other facilities of the Bessemer & Lake Erie Railroad Co., and Pymatuning Dam, a water storage and flood control project. General arrangements for the trip were made by F. R. Layng, vice-president and chief engineer of the Bessemer & Lake Erie, and detailed plans were handled by Laurence Spalding, valuation engineer.

OKLAHOMA

ASCE ASSISTANT SECRETARY James E. Jagger attended the Section's third meeting of the year—held in Oklahoma City on June 18—and spoke on current activities of the Society. In particular, Mr. Jagger discussed the two proposed amendments to the constitution, emphasizing the need for all members to vote on both amendments.

SAN DIEGO

PROGRESS MADE IN controlling workability of concrete was reviewed by Hugh Montgomery, district manager and field engineer for the Master Builders Co., at the June 26 meeting. The speaker also described the advantages of using "possilith," manufactured by the Master Builders Co., which is claimed to give greater workability and increased strengths without requiring the detailed field and laboratory control required by some admixtures. A potluck supper at the home of Fred Pyle concluded the evening.

TENNESSEE VALLEY

THE NEW HOLSTON Sub-Section closed its season with a picnic meeting. About 50 were present to enjoy the beauty of Dennis Cove in the mountains near Elizabethton. While a short business meeting was in session, the guests swam and worked up appetites for the fine catch of fish provided by Sidney N. Smith, chairman of the picnic committee.

Engineering and geology in Puerto Rico and the Philippines were discussed by Robert A. Laurence in an informative talk at the Knoxville Sub-Section's last meeting of the season. Mr. Laurence, who is regional geologist for the U.S. Geological Survey, illustrated his talk with maps and slides.

TEXAS

A TALK ON "Sedimentation Surveys in the Drainage Basin Program" featured a recent luncheon meeting of the Fort Worth Branch. This was given by Victor H. Jones, of the U.S. Soil Conservation Service. Other speakers were Lt. Comdr. R. W. Wheeler, Jr., of the Navy Civil Engineer Corps, who explained the details of the veterans' memorial to be erected in Fort Worth, and J. K. Alewine and Dudley Lewis, who reported on the spring meeting of the Texas Section.

TRI-CITY

VARIOUS PHASES OF the national airport program were discussed by a panel of speakers from the Stanley Engineering Co., Muscatine, Iowa, at a dinner meeting of the Tri-City Section held in Muscatine. H. S. Smith opened the discussion with a general explanation of the program. He was followed by Clarence Whalin, who described details of design, and J. B. Tracy, who talked on airport planning.

SAN FRANCISCO

THE JOINT ARMY-NAVY report on a second San Francisco Bay crossing was discussed by Commodore Lewis N. Moeller, of the Navy Civil Engineer Corps, at the regular June meeting. Other recent activities have included trips to inspect the cyclotron on the University of California campus and the facilities of the Hunters Point Naval Shipyard. The latter tour was sponsored by the Junior Forum. This year the Section's prize of Junior membership in the Society goes to Richard Milne Bartle, graduating member of the Student Chapter at Stanford University.

SEATTLE

ENGINEERING ASPECTS of a recent trip to Europe were described at the June meeting by Frederick B. Farquharson, professor of civil engineering at the University of Washington. Commenting on the wartime destruction of London, Professor Farquharson stated that Great Britain is planning some interesting new engineering projects, including a suspension bridge over the River Severn. Professor Farquharson also described a visit to UNESCO headquarters and reported briefly on the Sixth Annual Conference on Applied Mechanics, which he attended in Paris.

WISCONSIN

JUNIORS IN THE Section, under the leadership of William Mark, sponsored the Section's annual Ladies' Night and took entire charge of the program. Principal guest speaker was Elmer R. Nelson, curator of geology at the Milwaukee Museum, who gave an illustrated lecture on the new Big Ben National Park. Construction of an expressway to relieve traffic congestion in Milwaukee is being urged by the Section's Committee on Civic Problems, following a study of the Milwaukee Metropolitan Area survey, conducted jointly by the PRA and the Wisconsin Highway Commission.

STUDENT CHAPTER Notes

NEWARK COLLEGE OF ENGINEERING

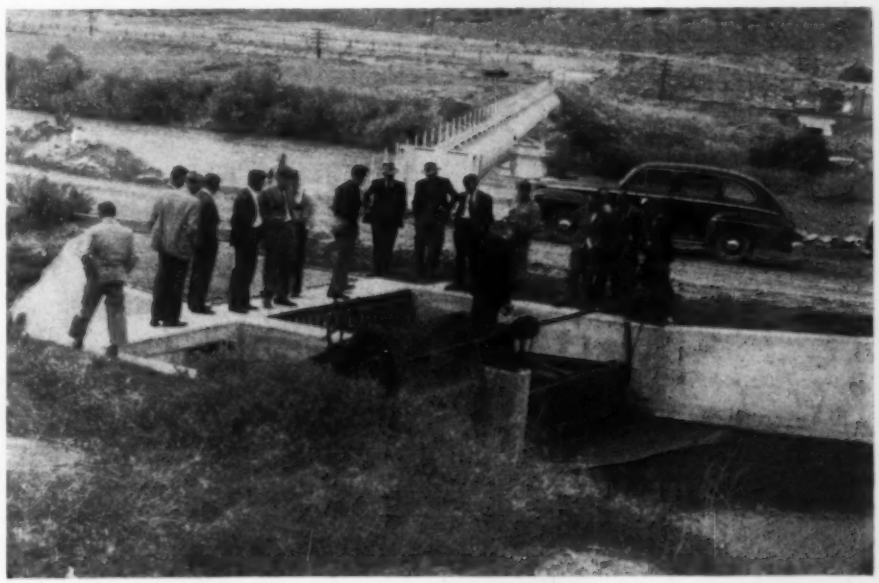
A PICNIC AND junior-senior baseball game closed the school year's activities for members of the Newark College of Engineering Student Chapter. Recent projects of the Chapter have included inspection trips to the Wanaque Reservoir, the Little Falls plant of the Passaic Valley Water Commission, the Rockaway Valley sewage disposal plant, and the Tallman's Island sewage treatment plant. Among the prominent engineers who have spoken in recent months are Charles H. Capen, chief engineer of the New Jersey District Water Supply Commission; Howard T. Critchlow, ASCE Director and chief engineer for the division of water police and supply of the New Jersey Department of Conservation; Roger H. Gilman, assistant to the director of port development for the Port of New York Authority; Morris Goodkind, bridge engineer for the New Jersey Highway Department; Peter Homack, sanitary engineer with Elson T. Killman, New York City hydraulic and sanitary engineering firm; and James E. Jagger, Assistant Secretary of the ASCE.

UNIVERSITY OF TEXAS

RECENT ACTIVITIES of the University of Texas Chapter ranged from a picnic at Prof. J. A. Focht's cabin near Buda to several technical sessions. Meeting topics included the testing of highway materials, which was discussed by Marshal Brown, of the Texas State Highway Testing Laboratory; the hydrology of the Colorado River Valley of Texas, by G. G. Commons, of the State Reclamation Bureau; and design problems of dams on the Colorado River, by C. S. Adams, of Houston. Several Chapter members attended the Spring Meeting of the ASCE in Phoenix, Ariz.

MONTANA STATE COLLEGE

INSPECTION OF THE Montana Highway Department offices and laboratory followed by a visit to a gold dredge and a sand and gravel plant occupied most of an all-day field trip members of the Chapter made to Helena and the vicinity. After a luncheon with Section members, the student group motored to Toston Dam on the Missouri River to inspect the Broadwater irrigation project. Officials of the U.S. Geological Survey demonstrated the procedure used for gaging streams. The trip was planned by members of the Montana Section.



MEMBERS OF MONTANA STATE COLLEGE Student Chapter inspect Broadwater irrigation project at Toston Dam on Missouri River during one-day field trip which was made to Helena and vicinity.

Purdue Students Electrocuted Measuring Height of Tower

TWO PURDUE UNIVERSITY Student Chapter members were electrocuted recently in an attempt to measure the height of an observation tower at the university's experimental camp 15 miles southwest of Lafayette, Ind. A third suffered minor burns and shock.

Walter F. Brown, senior from Indianapolis, and John C. Roeder, sophomore from Carrollton, Ky., were killed instantly, and Mack L. Ritchie, a sophomore from Litchfield, Ill., was injured. Police said a metal tape the students had thrown to the ground from the top of the 60-ft tower was blown across a 7,200-volt electric line nearby.

NEWS BRIEFS

ABOUT ENGINEERS AND ENGINEERING

New Federal Rent Act Removes Most Controls on Non-Residential Building

FEDERAL CONTROLS OVER virtually all non-residential construction were removed June 30 when President Truman signed the Housing and Rent Act of 1947. The new law extends modified rent controls to March 1, 1948, but permits voluntary rent increases of up to 15 percent.

The provision likely to have the greatest effect on the construction industry is the lifting of controls designed to prevent diversion of building materials from home to non-essential and deferable construction. Increased demand for materials and labor resulting from removal of these controls may delay a decline in building costs and even result in further cost increases, the President warned in his message to Congress.

Housing Expediter Frank R. Creedon told the Washington Building Congress recently that $3,000,000,000 worth of non-housing construction was waiting to start. He said removal of construction controls would reduce the housing program by more than 200,000 homes from the million new dwelling units he predicted earlier this year (See CIVIL ENGINEERING, July 1947, page 60). The controls that formerly permitted the housing expediter to limit non-housing building to $50,000,000 a week prevented the starting of nearly $2,000,000,000 of such work last year.

Only amusement and recreation projects are still under construction controls. Only a small fraction of the construction not approved last year was planned for these purposes. State and county fairs and agricultural, livestock and industrial expositions are excepted from the section permitting the housing expediter to require permits for amusement purposes if he feels a shortage of building materials is likely.

Eliminated by the housing and rent control act are most of the features of the Patman Emergency Housing Act passed by the last Congress. Gone are priority control on the distribution of construction materials, ceiling prices on the sale of new homes and the housing expediter's power to order the Office of Price Administration to change the ceiling price on building materials.

Among the few Patman Act provisions retained are the office of housing expediter (until Feb. 29, 1948), allocations previously granted and price limitations on housing construction begun with priority aid. Homes built for sale still must be reserved for at least 30 days after completion for veterans wishing to buy or rent.

Under the Patman Act 670,500 permanent family housing units, in addition to more than 300,000 units of other types, had been started by the close of last year. In the first five months of this year 280,300 new permanent family dwelling units were begun and 300,000 were completed.

Saving of 10,000 Lives Asked in Highway Safety Meeting

AMERICA'S HIGHWAY accident death toll already has turned sharply downward, President Truman told engineers and highway officials attending the recent President's Highway Safety Conference in Washington, D.C. Saving of 10,000 lives is the goal of this year's Action Program for highway safety. Last year's fatality rate of 9.8 deaths per 100 million vehicle-miles was the lowest recorded in the automotive history of the United States. While travel in this country during the postwar year of 1946 exceeded that of the prewar year of 1941, 6,500 fewer persons were killed in highway accidents. The early months of 1947 showed a continuation of this favorable trend.

An eight-point program was outlined by Gibb Gilchrist, M. ASCE, president of Texas A. and M. College and chairman of the conference's engineering committee. It called for coordinated safety activity by all groups of government officials, highway engineers, civic groups, educators, police and planning groups.

The committee recommended that each state draw up a long-range highway improvement plan and that traffic safety research be increased, preferably in coordination with the Highway Research Correlation Service. States also were urged to make maximum use of the 1½ percent fund authorized in the 1944 Federal-Aid Highway Act for research and economic investigations and to revise their grade crossing laws along the lines of the 1944 highway act. Additional suggestions were greater use of the access control feature in highway construction and better reporting of highway accidents.

Substantial acceleration of the engineering part of the Action Program was reported by the engineering committee. Planning for highway safety, conducted under the auspices of the California legislature, was cited as an example of comprehensive statewide road planning. (See CIVIL ENGINEERING, April 1947, page 22.) Progress has been made toward raising of design standards and nation-wide uniformity of signs, signals and pavement markings.

Connecticut, with a death rate last year only half the national average, received an award in recognition of its outstanding safety record. Other awards of the 1946 national safety contest went to Omaha, Nebr., and Washington, D.C.

State meetings for advancing local programs will replace the national conference in 1948.

Iowa Building Council Named to Draft Code for State

A TEN-MEMBER Building Code Council for Iowa has been appointed by Governor Robert D. Blue. The appointment followed passage of an act by the Fifty-Second General Assembly providing that a group of engineers, architects, contractors and legislators be named to make a two-year survey and draw up a state building code for submission to the legislature in 1949.

Frank Kerekes, M. ASCE, assistant dean of engineering at Iowa State College, was elected chairman of the council at an organization meeting called by the Governor. J. H. Ames, Assoc. M. ASCE, city manager of Ames and chairman of the Building Code Committee of the Iowa Engineering Society, was chosen temporary secretary until the appointment of a permanent technical secretary by the council.

Other council members appointed were two architects, Charles Altfillisch, Decorah, and Burdette Higgins, Des Moines; two contractors, Arthur D. Ladehoff, Clinton, and F. W. Mast, Waterloo, and four legislators—Senators George Faul, Des Moines, and Oscar Hultman, Stanton, and Representatives R. E. Duffield, Guthrie Center, and Charles Knickerbocker, Fairfax.

Latin Americans Receive New Engineering Quarterly

COPIES OF THE first issue of *Adelantos de Ingenieria*, a new engineering quarterly that reprints a selected list of recent articles from North American engineering journals, have been sent to engineering societies and associations throughout Latin America. The new publication is planned to serve engineers in the other American republics by making available the current articles believed to be of greatest interest to them.

Experimental in nature, the first issue contains reprints in the languages in which the articles were originally published. Later quarterlies may be translated into Spanish or Portuguese if the Latin American

engineers indicate such a preference. Other modifications may be necessary to make the publication of maximum usefulness.

Editors representing the five leading North American engineering societies and the magazine *Ingenieria Internacional* select the articles and arrange for their reproduction. The new publication is a cooperative project of the National Research Council through its division of engineering and industrial research, represented by the division's chairman, Dean F. M. Feiker, George Washington University; the Inter-American Development Commission, represented by M. D. Carrel, projects director, and the Engineers Joint Council through its committee on international relations and more particularly its commission on Latin America, represented by the commission chairman, Dean S. S. Steinberg, M. ASCE, University of Maryland.

Educators Discuss Shortage of Engineering Instructors

SHORTAGE OF TEACHING staff, likely to become more acute in the next several years, is a major problem confronting engineering schools, speakers told 90 educators attending the civil engineering division of the recent annual meeting of the American Society for Engineering Education in Minneapolis.

Young and inexperienced staff members are the general rule, the faculty members agreed. Civil engineering educators would welcome the support of industry in giving part-time and summer employment to younger instructors so that practical experience could be gained.

Papers on the problems of teaching structural design and analysis, soil mechanics, photogrammetry and transportation were presented. The need of soil mechanics as a fundamental course in the civil engineering curriculum was stressed, and the importance of integrating the teaching of design with respect to the prime structural materials—steel, concrete and wood—was discussed.

Samuel T. Carpenter, Assoc. M. ASCE, Swarthmore College, was elected chairman of the division for the coming year. Chosen as directors were Glen N. Cox, M. ASCE, Louisiana State University; R. E. Fadum, Assoc. M. ASCE, Purdue University; E. A. Gramstorff, M. ASCE, Northeastern University; and J. K. Vennard, Assoc. M. ASCE, Stanford University. Prof. W. S. Evans, M. ASCE, University of Maine, past-chairman, remains on the executive committee, and Prof. L. S. Le Tellier, M. ASCE, The Citadel, is the representative on the General Council.

July Construction Bid Calls Announced by Bureau of Reclamation

SEVERAL LARGE CONSTRUCTION projects are scheduled to get under way in Western states soon, according to the Bureau of Reclamation's *Advance Construction Bulletin* for July. Announcements of July bid calls are published for information only and are subject to revision, the bulletin says. For further information on these projects, readers may write to the Chief Engineer, Bureau of Reclamation, Denver 2, Colo., or to the nearest regional director.

LATERALS—STRUCTURES
W. C. Austin (Altus) Project, Oklahoma

Location: South of Altus, Okla.
Work: Construction of Altus laterals 21.5 to 21.7 and structures.

Excavation	260,000 cu yd
Concrete in structures	2,200 cu yd
Concrete pipe	4,500 lin ft

Time Allowed for Completion: 270 days.

WEIR
Cambridge Diversion Dam, Frenchman–Cambridge Unit, Missouri Basin Project

Location: Near Cambridge, Nebr.
Work: Construction of concrete weir for diversion of the Republican River into the Cambridge Canal.

Excavation	1,800 cu yd
Reinforcement steel	253,000 lb
Concrete	4,100 cu yd
Riprap	800 cu yd

Installing 43,200 lb of radial gates and hoists.
Time Allowed for Completion: 450 days.

TRANSMISSION LINE
Parker Dam to Pilot Knob Line, Davis Dam Project

Location: San Bernardino, Riverside and Imperial Counties, California.
Work: Construction of 123 miles of 161-kv transmission line, with overhead ground wire, from Parker Dam to Blythe, thence to Pilot Knob; wood poles, H-frame type.
Time Allowed for Completion: 300 days Parker to Blythe; 450 days Blythe to Pilot Knob.

PUMPING PLANTS
Klamath Project, Ore.

Location: Northern California, 10 miles southeast of Tulelake.
Work: Construction of pumping plants G, H, J, K, L and M, and installation of eleven pumps of 7 to 15 cfs capacity. Plants G and H to be enclosed in wooden superstructures; J, K, L and M to be weatherproof installations without housing.

Excavation	4,600 cu yd
Concrete	575 cu yd
Concrete pipe (18- to 30-in. dia)	1,100 lin ft
Timber piling	1,100 lin ft
Reinforcement steel	90,000 lb

Time Allowed for Completion: By March 1, 1948.

CABLEWAY—GAGING STATION
Davis Dam Project, Arizona–Nevada

Location: Davis Dam, Colorado River, 30 miles west of Kingman, Arizona.
Work: Erection and installation of cableway (approximate length: 1,000 ft) and gaging station.
Time Allowed for Completion: 150 days.

PIPELINE—STORAGE TANKS
Boulder City, Boulder Canyon Project

Location: Southern Nevada.
Work: Laying 6 miles of 12- and 14-in.-dia high-pressure steel pipe, and erection of 50,000- and 2,000,000-gal storage tanks.
Time Allowed for Completion: 360 days.

YEAR'S TRAINING IN AMERICAN RECLAMATION METHODS ends for 13 young Chinese engineers with awarding of certificates of merit at Bureau of Reclamation offices and laboratories in Denver. Costs of training, arranged by State Department, are borne by Chinese government. Kenneth Markwell, M. ASCE, Assistant Commissioner of Reclamation, congratulates Huai-Yun Hsu, of National Resources Commission of China, who has charge of group. Others seated at table are Donald P. Barnes, M. ASCE; Walker R. Young, M. ASCE, and Sumner P. Wing, Assoc. M. ASCE, all of Bureau of Reclamation staff in Denver.

Building Deflation Expected to Be Less Than in 1920

POSTWAR DEFLATION OF building material prices and construction costs probably will be considerably less in the next few years than it was 27 years ago, F. S. Dodge Corp., a fact-finding organization for the construction industry, estimates.

After World War I construction costs rose to a peak of about 150 percent over the war period, dropped spectacularly about 100 points, and rose again to a stabilized level about 100 percent over prewar costs. This time the peak has not been nearly so high.

Construction costs show an increase of from 50 to more than 90 percent over 1939, depending upon the material. Index numbers used in Fig. 1 are in a sense theoretical. They take account of quoted material prices, official hourly wage scales, and normal contractors' overhead and profit but omit excess costs incurred by unusual difficulties in procurement of materials, frequent stops and starts on projects, abnormal overtime pay combined with bonuses, and the general low level of labor productivity. Such factors have added 15 to 25 percent to costs based on current material prices, standard wage rate, and normal overhead and profit. Some of these excess costs have already begun to disappear.

Latest figures, illustrated in Fig. 2 show building materials at a price level 96 percent above the 1939 average. But pressures have varied considerably, and price increases range from 23 percent for cement to 189 percent for lumber.

A return to the prewar costs of living would be disastrous to the whole economy and few people expect it, the Dodge Corp. says, predicting that postwar living costs may stabilize in the range of 45 to 55 percent over prewar. This would be about the same percentage of increase seen after World War I.

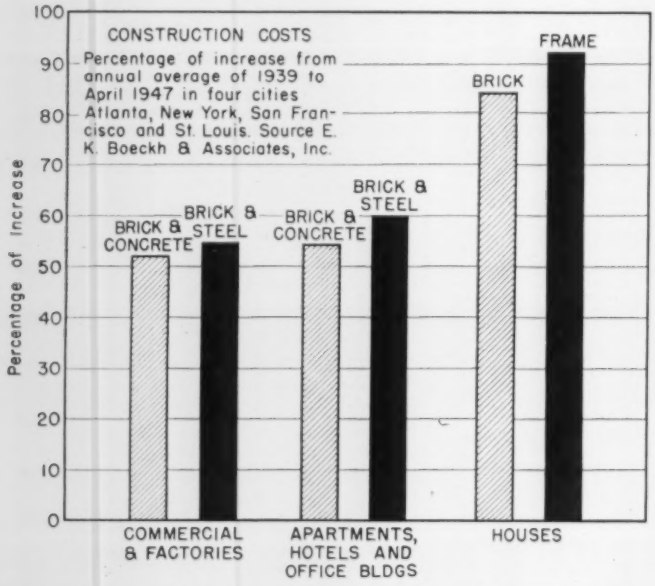


FIG. 1. CONSTRUCTION COSTS have risen sharply since 1939. Because lumber and paint are used extensively in home building, residential costs reflect disparity with other types of construction. These two materials have shown greatest price increases.

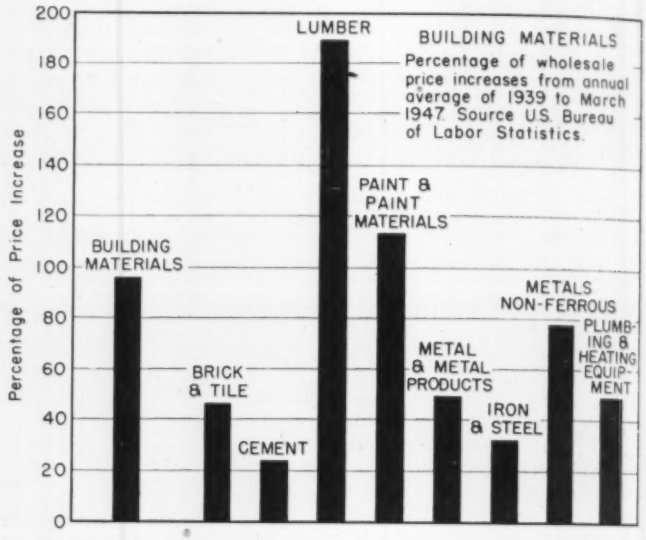


FIG. 2. SPECTACULAR PRICE increases in lumber have contributed much to overall price jump. Recent reports indicate slight fall for some grades. Most building products show moderate gains compared to 1920–1921.

States Win Year of Grace for Federal Highway Aid

AN ADDITIONAL YEAR in which to qualify for federal highway aid has been granted to the states by an amendment to the Federal-Aid Highway Act of 1944. The amendment approved by Congress in June, gives state highway departments an extra year of grace in which to take advantage of the $500,000,000 a year made available by the act.

Many highway programs that otherwise would have been launched under the act have been delayed by shortages of materials, equipment and manpower. Some state highway departments voluntarily deferred highway programs to comply with President Truman's request for a moratorium on public works until the materials situation improved.

Public Roads Administration officials estimate that 65,000 miles of highway are in need of reconstruction and that many thousands of miles more must be stepped up to the four-lane design. The majority of arteries into cities need redesigning.

Bridge, Structures Group to Hold Congress at Liege

PAPERS ON FIVE THEMES will fill the agenda when the International Association for Bridge and Structural Engineering holds its next congress at Liege, Belgium, during the first half of September 1948.

Themes to be discussed at the congress are assembling devices and structural details in steel structures, developments in building structures in concrete and masonry, developments in long-span bridges, slabs and various curved structures of reinforced concrete, and analysis of safety and effect of dynamic forces.

Individual Sewage and Water Standards Outlined by FHA

STANDARDS FOR INSTALLATION of individual water-supply and sewage disposal systems have been developed by the Federal Housing Administration in cooperation with state and local health authorities. They represent the minimum requirements for safeguarding health and maintaining sanitary conditions in the community.

These requirements are available as a guide to all builders of homes confronted with obtaining their water supply on the site and disposing of the sewage by individual systems, in locations where public or community water or sewerage systems have not been installed. The Federal Housing Administration points out that for reasons of health these systems must be properly installed, must be easily maintained, and must be constructed so as to avoid contamination.

R. Robinson Rowe, M. ASCE

THE AUGUST MEETING of the Engineers Club was unusually jovial; the members who hadn't solved the problem of the toddy glass beforehand had been working it out with full-scale models at the bar. "Practical," admitted Professor Neare, "but not rigorous. The proof is always difficult for the axiom, when the obvious is true, and for the fallacy, when the obvious is false. Models only witness that the obvious is obvious. Our Guest Professor Eepe may have led you astray."

"I tried to, Noah. Let's see if Joe Kerr saw the point. The riddle, Joe, was whether Otto Drinkwater doubled his 2-finger dose to 4 fingers by tipping his glass as he measured."

"He did, with an extra wallop," answered Joe, "but I wish I had waited to prove it with 100-proof models. The truncated cone formula gave 5.6 in.³ for the 2-finger slug without trouble, but I wasted two evenings expressing Otto's nightcap in

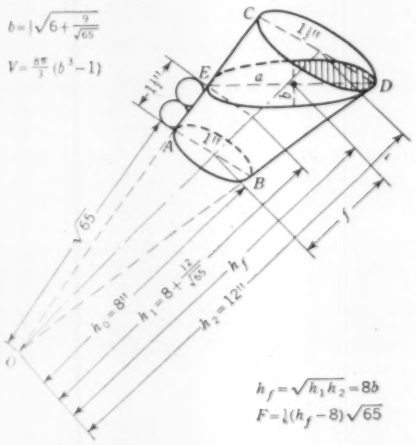


Fig. 1. The tippler tips the tumbler.

elliptic integrals. Then I saw that it was the difference between the oblique elliptical cone *ODE* and the right circular cone *OAB*. After some wrestling with the altitude of *ODE* and the semi-axes of its base, I found the volume to be 11.5 in.³, or more than double 5.6."

"Quite awkward and futile," jeered Cal Klater. "The minor semi-axis, *b*, would have been enuf, since the volume varies as its cube and cone *OAB* is a special case with unit base. The futility is that Joe thinks 2 × 2 is always 4, but 4 fingers is 13.28 in.³ and much greater than 2 times 2 fingers! Hence Otto did double his dose, but not to 4 fingers."

"Exactly, Cal, and I'm glad you added your formulas to Joe's figure. It is interesting that the axial components of extreme distances *OE* and *OD* have for a geometric mean the altitude of an equivalent right circular cone, marking the level at which the liquid would stand if the glass were righted. Noah just whispered to me that Joe had invited him to a demonstration at the bar and asked me to reintroduce Stoop Nagle as Guest Professor. Another drawbridge problem, Stoop?"

"No, Eepe, just chaining with a one-man chain. My friend Si Klurr contracted to measure by chain from the SE corner of a regular township north to an acceptable public-survey monument from which the scribing had been effaced. Si made money by using the chain of his diophantine bike.

"For his start at one monument, he set his master link at the top of the rear sprocket and painted the top tooth of each sprocket. Cycling directly to the other monument, he found the painted tooth again at the top of the rear sprocket, but the master link had advanced 13 links and the front sprocket had advanced 23 teeth from the starting positions.

"Now a diophantine bike has 13 teeth in the rear and 29 in the front sprocket, connected by a 61-link chain. Knowing that the circumference of his rear wheel was 6.6 ft, Si verified the government measure. Identify the second monument."

[*Cal Klaters were Richard Jenney, John L. Nagle, John W. Pickworth, Anne Othernut (J. Charles Rathbun) and Homer W. Woodbury, and Guest Professors are known outside the Club as E. P. (Eepe) Goodrich and John L. (Stoop) Nagle.*]

Meetings and Conferences

American Congress on Surveying and Mapping. Aug. 14 and 15 are the dates for the seventh annual meeting of the American Congress on Surveying and Mapping, to be held at the Statler Hotel in Washington, D.C.

International Association for Bridge and Structural Engineering. Technical papers on five general topics are scheduled for presentation at the next congress of the International Association for Bridge and Structural Engineering during the first half of September 1948, at Liege, Belgium. Steel structures, concrete and masonry developments, long-span steel bridges, reinforced concrete and dynamic forces will be discussed.

World Power Conference. National and international adjustment of sources of heat and power will be the topic of discussion at an international fuel economy conference sponsored by the World Power Conference, Sept. 2 to 9 at The Hague, Netherlands. Under consideration will be the production, distribution and utilization of fuels of all types, with special reference to wartime experiences and to developments realized since 1939 or now in prospect.

CANADIAN ENGINEERS AND LAW-MAKERS have set up a joint parliamentary and scientific committee like that which has existed in Great Britain for more than ten years.

THE UNION PACIFIC will build an $8,000,000 tunnel through the divide between Altamont and Aspen, Wyo.

COLUMBIA RIVER FLOW is getting less and less each year.

LOCAL RESIDENTS in the vicinity of Hoover Dam have felt some 500 earth shocks since 1936 and some 4,000 have been recorded by the seismograph station at Boulder City since 1938.

ELECTRIC ENERGY is now delivered for as little as a cent a horsepower, while the same amount of human energy costs $10.

CONSOLIDATED EDISON IN NEW YORK delivers enough electricity in a day to do the work of 3 million draft horses.

KNOWN COMMERCIAL GRADES of zinc and lead and bauxite are expected to be exhausted before 1960.

THE ELECTRIC POWER INDUSTRY uses less than 40 percent as much coal per kwhr now as in 1930.

PRIVATE INVESTMENT is 84 percent greater than a year ago.

IN 1946 THE electric utility industry consumed about 70 million tons of coal, using an average of 1.29 lb per kwhr.

ABOUT 70 PERCENT OF ALL FARMS in the country are now within one-quarter of a mile of a power line.

50,000,000 AMERICANS rely on rivers and streams for drinking water; Dr. Thomas Parran, Surgeon General, U.S. Public Health Service, says these sources are so polluted as to be a menace to national health.

THE 50,000,000TH AUTOMOBILE rolled across Golden Gate Bridge just 19 days short of the span's tenth anniversary. $25,000,000 in tolls were collected up to May 1, 1947.

A 1,300-FAMILY APARTMENT PROJECT is proposed in Los Angeles. Estimated cost $15,000,000.

PORTUGAL is the world's largest producer and exporter of cork. Cork plantings cover more than 1,300,000 acres.

ALTHING," Iceland's legislative body, dates from 930 A.D.—the world's oldest parliamentary assembly.

SINCE 1900 the yearly death rate from tuberculosis has been reduced from over 200 per 100,000 to under 40.

THE WEST PRODUCES 50 percent of the nation's minerals, 49 percent of the timber and 32 percent of agricultural raw materials.

New Argentine Regulations for Registration of Technicians Limit Status of Foreign Engineers

NEW ARGENTINE REGULATIONS for the registration of technicians have clarified the status of American engineers and firms seeking to work there. The American Embassy in Buenos Aires has prepared the following summary of the new rules on "General conditions for the registration of private firms, professional entities, contractors, engineers, architects and surveyors, for contracts of studies and/or projects for drainage works and complementary installations in Argentina."

Art. 1. For the purposes of inscribing in a Registry, which will be opened for this object, firms desiring contracts to carry out studies and/or projects of drainage works, the latter will be classified in the following categories:

First category: Important projects for drainage works and/or complementary installations, the preparation of which demands specialized technical knowledge and experience in similar work.

Second category: Projects of work in general that does not require strictly specialized technical knowledge or for which the Administration General of Sanitary Works already has prepared preliminary projects or has projects that must be modernized.

Third category: Surveying and altimetric projection of aqueducts, piping systems, etc.

Art. 2. All Argentine or foreign private firms, professional entities or engineers who can accredit the necessary technical capacity, are eligible to register in the first category.

In addition to those mentioned for the first category, engineers or architects graduated from a national university are eligible for the second category.

In addition to those mentioned for the first and second categories, firms specializing in surveying and surveyors and geographical engineers graduated from a national university are eligible for the third category.

Art. 3. Firms who are the exclusive possessors of, or are purveyors of representatives of systems of machinery which can be used in general drainage work, and contractor firms will not be eligible to register in either the first or the second categories.

Art. 4. Foreign firms which register in any of the three categories must act through the intermediary of a technical representative graduated from a national university, and they must establish their legal residence in the city of Buenos Aires.

The technical representatives of foreign firms established abroad must submit the original, or a legalized copy, of the power of representation granted to them and accompany this document with such authentic information as may be supplied by the official representatives of the country of origin.

Art. 5. The Administration General reserves the right to reject the registration of firms which, in its opinion, do not fulfill sufficiently the technical requirements, and it can officially order the elimination of firms, such as contractors, which have not fulfilled to entire satisfaction the work undertaken.

The Administration General may verify, whenever it deems it advisable, the references submitted by the registered firms.

Art. 6. Contracts for studies and/or projects will be granted only by public or private tender, whichever the Administration General deems most advisable in each case, and they will be fulfilled in accordance with specifications establishing the object of the tender, the standards by which the contractor will be governed, the form of payment, the time limit for each job to be completed, etc.

Art. 7. In the case of private tenders, the Administration General reserves the right to determine the amount of the work which, in its opinion, can be assigned to each firm registered.

Art. 8. In accordance with clause (d) of Article 47 of Law 12961, the Administration General reserves the right to contract directly with one or more private firms registered for the execution of projects and/or studies which, in its opinion, it considers advisable to entrust to experienced firms or technicians.

Art. 9. The studies and/or projects will be carried out under the permanent supervision of the Direction General.

Art. 10. The private firms desirous of registering should submit their request accompanied by the respective authentic documents and other references which vouch for their technical capacity in each category.

ANALYSIS OF NEW REGULATIONS

As an engineer who has handled many assignments in foreign countries, Dr. D. B. Steinman, of the consulting firm of Robinson & Steinman, New York, analyzes the significance of the new Argentine regulations in the following comments.—Editor.

On behalf of the National Council of State Boards of Engineering Examiners, as chairman of its Committee on Interstate Registration (or Registration by Endorsement), I have been exerting my efforts for a number of years toward eliminating or minimizing the barriers to interstate practice of qualified engineers. Our committee has recently been asked and instructed to extend its activities to the problems of international practice. In a recent article entitled "One World—One Profession," I recorded a plea for international cooperation and courtesy to eliminate international barriers to professional practice; and in a current committee report I have outlined a program toward securing the desired objectives through establishing mutual understanding and reciprocal courtesy with our fellow engineers in other countries.

The new (1947) regulations of the Argentine government apply to engineers, architects, surveyors, and contractors, interested in securing contracts for studies, design, or execution of drainage projects and related work in Argentina. The prescribed registration is in the nature of prequalification before any individuals, firms, or corporations may even submit proposals for such work. The necessary technical capacity must be established (by documentary evidence and references) for prequalification.

Foreign firms, upon regi tration, must act through a local engineering representative who is a graduate of a national university (in Argentina), and must establish an office in Buenos Aires, in order to maintain eligibility for consideration.

Firms controlling, selling or representing machinery or equipment that can be used on the drainage projects are disqualified.

Engineering contracts will be awarded by public or private tender.

Approval of firms on the registered list is subject to the judgment of the Administration General, and any firms or contractors who have not fulfilled an engagement to the entire satisfaction of the Administration General may be stricken from the eligible list for future work.

The necessity of retaining a qualified local engineer as a representative or associate and of establishing an office at Buenos Aires, all in the hope of securing a professional engagement or contract, would appear to be burdensome. There would be less objection to these requirements if they became effective after an engineering engagement or contract is awarded.

It is gratifying, however, to note that outside engineering talent is welcomed, upon proper qualification, without requiring written examinations, citizenship or established residence, and without imposing on the foreign engineer any discriminatory taxes, tariffs or other burdens designed to exclude him.

Boysen Dam Bids Sought on Big Horn River Project

BIDS FOR THE construction of Boysen dam and power plant on the Big Horn River in Wyoming, about 20 miles south of Thermopolis, will be opened by the Bureau of Reclamation August 20.

Boysen dam, a multiple-purpose unit of the Missouri Basin development plan, is to be an earthfill structure approximately 150 ft high and 1,000 ft long, with a concrete spillway. Approximately four years will be required to complete the work, which includes construction of a concrete power plant and relocation of 13.4 miles of Burlington Railroad track.

Construction of Boysen dam and appurtenant works and the railroad relocation will require the placing of 1,627,000 cu yd of earth material in the embankment, 4,800,000 cu yd of excavation and 117,000 cu yd of concrete in appurtenant structures. As part of the track relocation, a concrete-lined tunnel, 7,100 ft long, 17 ft wide and 25 ft high, will be constructed.

When completed, Boysen reservoir will have an active storage capacity of 820,000 acre-ft of water, which will be utilized for irrigation, hydroelectric power production, flood control and silt detention.

NEW IN Education

A TRAFFIC TRAINING COURSE held recently at the Georgia School of Technology attracted 119 persons from 21 states and three from Canada. Instruction was offered in traffic police operations, use of accident records, pedestrian protection, driver education and training, school transportation and traffic engineering, and a seminar on driver licensing procedures. An Institute of Public Safety has been established at Georgia Tech as part of the school's extension service under supervision of the department of safety engineering.

SIXTEEN EDUCATIONAL INSTITUTIONS have been offered one or more of 22 Eastman Kodak fellowships in chemistry, physics, engineering and business administration for the school year 1947–1948. For doctoral or master's work, they total $21,900. Six similar fellowships, totaling $6,300, are to be sponsored by the Tennessee Eastman Corp., a Kodak subsidiary.

THE UNIVERSITY OF CALIFORNIA at Berkeley will receive $920,000 to establish and operate for instruction and research an Institute of Transportation and Traffic Engineering under terms of a bill recently passed by the California legislature. The Institute is to concern itself with all related problems of public transportation, including highway safety, and is to cooperate in research with the state division of highways and other responsible agencies.

EXTENSION OF AERIAL PHOTOGRAPHY ANALYSIS to include all of Arctic North America has been made possible for Donald J. Belcher, associate professor of civil engineering at Cornell University, by a grant of funds from the Navy through the Arctic Institute of North America. Subject of the investigation is the use of aerial photographs for predetermining ground conditions influencing engineering structures in Arctic North America. Extension of the work across the Arctic fringe of North America will help to integrate knowledge of engineering construction in these remote areas. Professor Belcher expects to initiate field work east and north of Hudson Bay this summer. He also is a consultant on the U.S. Engineering Department permafrost investigation now under way in Alaska, where geologic and soil conditions are markedly different.

THIRTY-FIVE COLLEGES AND UNIVERSITIES in sixteen states are conducting forty-two credit courses in safety education, *Safety Education Magazine* reports. The majority include driver training with actual road instruction.

Oil, Gas Industry Ranks As Major Steel Pipe User

STEEL PIPE AND TUBES found their biggest market in the oil and natural gas industry during 1946, according to preliminary data prepared by the American Iron and Steel Institute. Shipments of 1,225,425 net tons of tubular products to the industry accounted for 26 percent of total shipments of these products and almost equaled the 1940 figure of 1,228,642 net tons. Another 8 percent of the total 4,633,231 tons of steel pipe and tubing produced in 1946 were exported.

Of the total amount shipped to the oil and gas industry in 1946, 716,424 tons went to jobbers, dealers and distributors and 419,995 tons went directly to the industry for construction purposes, including the building of pipelines.

Seamless pipe and tubing comprised about 60 percent of the various types sold to the oil and gas industry. Electric welded pipe and tubing made up the bulk of the balance.

President Asks $4 Billion For Flood Control Program

IMMEDIATE APPROPRIATION OF $250,000,000 for operations in the current fiscal year by the Army Engineers, the Bureau of Reclamation and the Soil Conservation Service was requested by President Truman in a recent special message to Congress in which he recommended the expenditure of $4,000,000,000 during the next ten years for flood control in the Mississippi River Basin.

The program is designed to prevent such disasters as last spring's floods in the Missouri and Mississippi Valleys. Monetary damage of the recent floods, the President said, might exceed the $500,000,000 loss suffered in 1937. He stated that flood damage in the Mississippi Basin from 1937 through 1946 has been more than $1,000,000,000, and that loss of hundreds of lives and much suffering have also resulted.

In the Flood Control Acts of 1928, 1936 and 1938, the President pointed out, Congress has authorized expenditures of $6,000,000,000 for flood control and related purposes, of which $3,500,000,000 to $4,000,000,000 is either directly or closely related to flood control.

Engineering Scene Exhibited

EVIDENCE OF THE popular appeal of engineering subjects is the attention attracted by this painting of a power shovel loading ore in a Utah copper mine, featured in a current exhibition of advertising art at the Metropolitan Museum of Art in New York City. The painting, the work of Peter Heick, shows a Marion Type 4161, of 5 cu-yd capacity, loading ore into rail cars. Named as among the 300 best of the 8,000 entries submitted, the painting was one of a series used in the 1947 calendars of the General Electric Company, Schenectady, N.Y.

New Publications

Airport Development. To aid in the development of a nation-wide system of public airports, the newly created Airport Division of the American Road Builders Association has issued two informative bulletins covering many phases of airport design and construction. Questions and answers presented at the "Town Hall Meeting on Airports," a feature of the 44th annual meeting of the ARBA, comprise Bulletin No. 115, entitled *Information for Airport Sponsors*. The pamphlet sells for $1 a copy. Bulletin No. 116, detailing the responsibilities of the state in the development of an airport program, sells for 75 cents a copy. Both may be obtained from the American Road Builders Association, 1319 F Street Northwest, Washington, D.C.

Engineering Lectures. Talks on engineering subjects of special interest to the young engineer—delivered by Willard T. Chevalier, M. ASCE, to the engineering school at the Agricultural and Mechanical College of Texas in April 1946—have been published as Bulletin No. 99 of the Engineering Experiment Station. Topics covered in the series of five lectures range from "The Technique of Study" to "Lecture to Veterans."

Railway Operations. The economics of postwar railroad operation are outlined in "A Review of Railway Operations in 1946," recently reprinted from *Railway Age* by the Association of American Railroads. The bulletin, issued as Special Series No. 76, may be obtained from the Bureau of Railway Economics, Association of American Railroads, Washington, D.C.

City Planning. Recommendations for a fundamental civic improvement and development program for the city of Omaha, Nebr., are covered in a 300-page volume recently issued by the Mayor's City-Wide Planning Committee after several years of intensive study. Supplementing the report are four special chapters—on Population; Land Use and Zoning; Parks, Recreation and Schools; and Housing—that have been issued by the Omaha City Planning Commission in pamphlet form.

NEWS OF Engineers

W. C. Huntington, head of the department of civil engineering at the University of Illinois, was recently awarded the honorary degree of doctor of science by his alma mater, the University of Colorado. Graduated in 1910, Professor Huntington subsequently was awarded the degrees of master of science and civil engineer. He taught in the civil engineering department there and became its head in 1919. In 1926 he came to the University of Illinois in his present capacity.

Carl Hugo Walther, of George Washington University, has been promoted to the rank of full professor of civil engineering. Professor Walther, who has been on the civil engineering faculty there since September 1939, also is assistant dean of the school of engineering.

LeRoy M. Hersum, consulting engineer, has reopened his engineering office at 6 Beacon Street, Boston, Mass. During the war he was a lieutenant-colonel in the Construction Section of the Army.

Louis Mitchell, dean of the College of Applied Science at Syracuse University, has been appointed to the New York State Flood Control Commission by Governor Dewey. He succeeds the late **Dr. Alfred R. Mann** on the 12-member commission, set up in 1936 to eliminate the hazard of floods in the state.

Edwin M. Grime, retired engineer of water service of the Northern Pacific Railway, St. Paul, Minn., has been awarded a certificate of life membership in the American Railway Engineering Association in recognition of his contribution to the work of its committee on water service.

William C. Hill has accepted a position as engineer with Earl K. Burton, Inc., Engineers, San Juan, Puerto Rico. His work will involve both structural and sanitary engineering. Formerly Mr. Hill was assistant sanitary engineer for the Chicago Pump Co., Chicago.

Neil P. Richards, previously with D. R. Warren Co., Los Angeles, Calif., has opened an office in the Professional Building in Los Angeles. A structural engineer, he will specialize in the design of commercial and industrial buildings and bridges.

Fred S. Childs, member of the firm of Bogert-Childs Engineering Associates, has been reappointed by Governor Driscoll of New Jersey to another five-year term on the State Board of Professional Engineers and Land Surveyors.

Charles B. Burdick was recently awarded an honorary membership in the Chicago Engineers' Club. Mr. Burdick, who is an Honorary Member of the ASCE, is a partner in the Chicago consulting firm of Alvord, Burdick & Howson.

Roy W. Crum, director of the Highway Research Board of the National Research Council, was honored at recent Iowa State College Alumni Day ceremonies when he received an Alumni Merit Award from the Alumni Club of Chicago. The award is bestowed upon outstanding alumni for meritorious service in their fields. Mr. Crum, a graduate of the class of 1907, served on the Iowa State engineering staff from 1907 to 1928. He is a Director of the ASCE.

C. G. Dandrow, vice-president of the Johns-Manville Sales Corp., and general sales manager of the company's industrial products division, has been elected to a five-year alumni term membership in the Massachusetts Institute of Technology Corp.

J. W. Hubler, of the civil engineering department at Washington University, St. Louis, has been appointed William Palm Professor of Civil Engineering there.

Francis E. Twiss has joined the staff of the Bureau of Highway Traffic at Yale University as a research assistant. He was released from active duty in the Navy Civil Engineer Corps last spring and, until his association with the Bureau, worked as a senior assistant engineer in the planning division of the City of Hartford, Conn.

John O. Eichler has been named acting head of the civil engineering department at the Cooper Union School of Engineering. Until last fall, when he joined the Cooper Union staff, Professor Eichler was on the civil engineering faculty at Syracuse University and civil engineer for the state highway department at Syracuse. In his new position he will replace **Kenneth C. Reynolds,** who resigned to take charge of the hydraulics department at the University of Southern California.

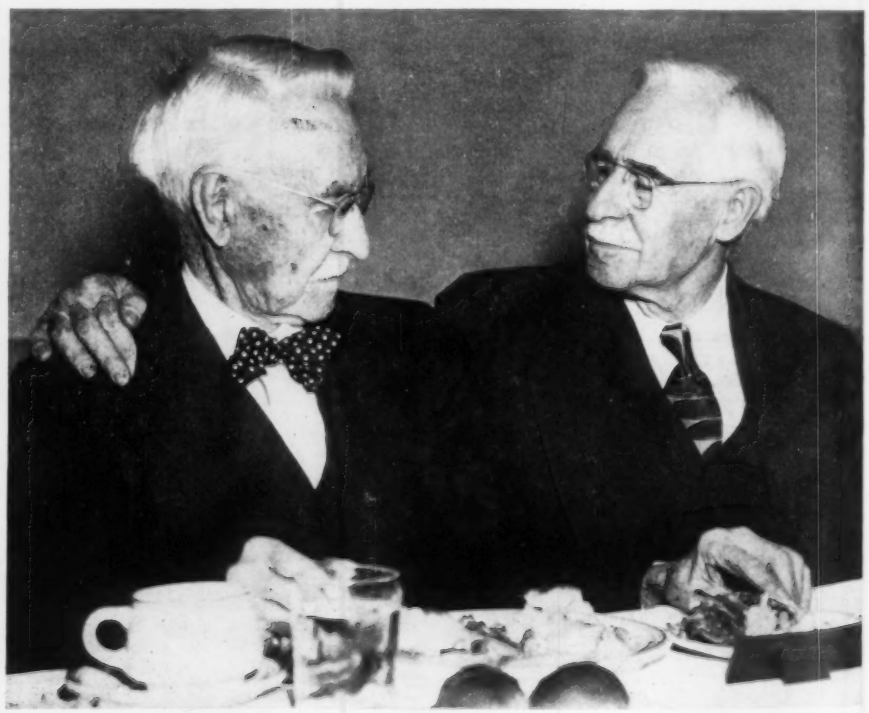
S. S. Steinberg, dean of the University of Maryland college of engineering, has been elected president of the Engineering College Administrative Council for a two-year term. The Council is composed of the deans of all the engineering colleges in the United States. Dean Steinberg also was elected vice-president of the American Society for Engineering Education at its recent meeting in Minneapolis.

Frank L. Lincoln and **Howard J. Williams,** long associated with Fay, Spofford & Thorndike, Engineers of Boston, Mass., have been admitted to partnership. The firm will continue under its former name.

Col. William Whipple is now executive officer to **Col. Theron D. Weaver,** North Pacific division engineer for the Army Corps of Engineers. He was previously in the Office of Military Government.

Carl H. Cotter has joined Blythe Brothers Construction Co. at Charlotte, N.C. He recently retired from the Navy with the rank of rear admiral after 29 years in the Civil Engineer Corps.

Col. E. V. Spence, of the Army Board of Water Engineers, is the new chairman of the Texas State Board of Water Engineers. He succeeds **C. S. Clark,** who resigned.



Rochester Democrat and Chronicle

EDWIN A. FISHER, HON. M. ASCE, and city engineer emeritus of Rochester, N.Y. (left), has unusual experience of attending banquet incident to retirement of his son, Lewis G. Fisher (right), from Rochester public service. Mr. Edwin A. Fisher is one of ASCE's oldest members having celebrated his 100th birthday on July 17. A full member since 1888, he is 13th on list of long-time Society members.

Albert **P. Greensfelder,** Honorary Member of the Society and board chairman of the Fruin-Colnon Contracting Co., St. Louis, Mo., has been named by President Truman as a member of the National Capital Park and Planning Commission. Mr. Greensfelder, who is widely known as a city planner, formerly represented the ASCE on the Joint Committee on the National Capital, advisory committee of the commission. The group, to which Mr. Greensfelder has been appointed, constitutes the city planning commission for Washington, D.C., passing on such matters as location of public buildings, streets, and parks.

A. P. Greensfelder

Allen Jones, Jr., has left the Tennessee Metal Culvert Co. to work for Baumann and Baumann, an architectural firm in Knoxville, Tenn.

R. E. Foerster, former junior hydraulic engineer with the forecasting section of TVA, is now employed by the Francis Engineering Co., Rockford, Ill.

Gilbert H. Dunstan, associate professor of sanitary engineering at the University of Alabama, has been reelected treasurer of the Alabama Water and Sewage Works Association.

Harold S. Ellington, president of the Detroit architectural and engineering firm of Harley, Ellington and Day, Inc., has been appointed to the Detroit Metropolitan Area Regional Planning Commission for a one-year term. The commission was established to develop a long-range planning program in the Detroit metropolitan area.

Oscar L. King is now field engineer for the Tennessee Valley territory of the Portland Cement Association. He has been Abingdon Township engineer at Abingdon, Pa.

Lee G. Warren, former project manager for several major TVA construction jobs, has opened an office in Chattanooga, Tenn. His organization, the Warren Engineering Corp., is making fuel market surveys in the Knoxville area for the Tennessee Natural Gas Co. Recently he has been administration manager for the Tennessee Eastman Co. at Knoxville.

Harvey Hicks Allen has been named city manager of Corpus Christi, Tex., succeeding **Roderic B. Thomas,** who has taken a similar position in Dallas. **Harry H. Stirman,** head of the engineering and construction division of the Corpus Christi department of public works, has taken over Mr. Allen's former duties as director of public works.

Elroy F. Spitzer, recently discharged from the Navy Civil Engineer Corps, where he was a lieutenant (jg), has been appointed assistant city engineer of Kenosha, Wis.

Frederic L. Copeland, vice-president of the Bates & Rogers Construction Corp., Chicago, Ill., will reopen the company's San Francisco office in September. Other staff changes include the promotion of **John W. Rogers** and **George N. Martin,** both former general superintendents for Bates & Rogers, to the posts of vice-president and treasurer, and vice-president, respectively. They will continue to have their headquarters in Chicago.

John G. Staack, chief topographic engineer of the U.S. Geological Survey since 1929, has retired after 43 years in government service. Mr. Staack spent his whole government career with the topographic branch of the Geological Survey, which he joined in 1904. During his term as chief topographic engineer he was instrumental in changing the topographic mapping methods of the Survey from ground to stereophotogrammetric.

Anton Rydland is now with the Kellex Corp. at Oak Ridge, Tenn. Until lately he was in Houston, Tex., as senior civil engineer for the Ambursen Engineering Corp.

William Stemwell, formerly administrative assistant to the chief design engineer of the Tennessee Valley Authority at Knoxville, Tenn., has become departmental engineer with Birch-Johnson-Lytle and will be in charge of the engineering department of their Seattle, Wash., office. The firm has a contract for construction work on army bases in Alaska.

Earnest Boyce, professor of municipal and sanitary engineering at the University of Michigan, has been appointed chairman of the civil engineering department there. He was formerly professor of sanitary engineering at the University of Kansas and chief engineer of the division of sanitation for the Kansas State Board of Health. In 1941 he served as water supply consultant for the Army in the office of the Quartermaster General and subsequently was senior sanitary engineer for the U.S. Public Health Service.

Earnest Boyce

Gordon M. Fair, dean of the graduate school of engineering of Harvard University and a member of the board of directors of the Rockefeller Foundation, is making a study of sanitary engineering research and education in Europe for the Foundation. His report will be used by that organization in planning its future engineering activities abroad.

R. M. Shipman has opened a consulting engineering office in San Antonio, Tex. Until lately he was in the construction division of the Veterans Administration in Dallas, Tex.

Joseph E. Jenkins has resigned as district sanitary engineer for the Fort Worth district of the Texas Health Department and is now associated with Joe Rady, Fort Worth consultant.

Kirby Smith has been promoted to the position of vice-president of the Raymond Concrete Pile Co., New York City. Last year he retired from the Navy Civil Engineer Corps, in which he held the rank of rear admiral, and was appointed general deputy expediter for the Veterans Emergency Housing Program. Admiral Smith was helped in this work by his experience in developing and supervising a $4\frac{1}{2}$-billion-dollar building program for the Navy in the United States and various strategic outposts, including Hawaii and the Canal Zone. He recently went from the housing position to the Raymond Concrete Pile Co.

Kirby Smith

Albert Raulin is now with the Illinois Division of Highways at Springfield, as civil engineer on railroad crossings. Formerly he was with Jenkins, Merchant and Nankivil, Springfield consulting firm.

Henry G. Porak has replaced **Charles H. Williams** as city engineer of Olympia, Wash. Mr. Williams continues as water superintendent and is also serving as inspecting engineer for a million-dollar water supply project under construction. Mr. Porak, who spent many years with the Washington Highway Department, has recently been assistant city engineer of Tacoma.

Fred G. Blackwell has resigned as civil engineer for the TVA at Jefferson City, Tenn., to accept a position with the Scioto-Sandusky Conservancy District at Columbus, Ohio.

I. N. Mayfield has left the U.S. Engineer Corps in Mineral Wells, Tex., and is now in the employ of the Portland Cement Association, with headquarters in Austin.

John A. Focht, Jr., who received his master of science degree in soil mechanics from Harvard University last June, is with the Waterways Experiment Station at Vicksburg, Miss.

W. L. Hempelmann, consulting engineer for the Chicago division of the asphalt sales department of the Texas Co., is retiring after 32 years of service. Before joining the Texas Co. in 1915, Mr. Hempelmann served the city of St. Louis, Mo., for nine years as engineer in charge of bituminous pavements and supervisor of the city's asphalt plant and laboratory. He has been active for many years in the American Public Works Association and the Association of Asphalt Paving Technologists.

W. L. Hempelmann

Rear Admiral Lewis B. Combs will become head of the department of civil engineering at Rensselaer Polytechnic Institute, Troy, N.Y., next January upon his retirement from the Navy, in which he has served since shortly after his graduation from R.P.I. in 1916. From 1939 through the war years Admiral Combs was assistant chief and executive officer of the Navy's Bureau of Yards and Docks and directed the Civil Engineer Corps. He was awarded the Navy Distinguished Service Medal, and is now director of the Atlantic division of the Bureau of Yards and Docks, with headquarters in New York. In the Rensselaer post, he succeeds **Emil H. Praeger,** now a partner in the New York consulting firm of Madigan-Hyland.

Lewis B. Combs

J. G. Turney has opened an office as consulting engineer in Houston, Tex. He was formerly director of public works and city engineer for Houston.

Murphy U. Snoderly, former city manager of Johnson, Tenn., has assumed his new duties as service director of Knoxville, Tenn.

Melvin R. Williams, formerly associate hydraulic engineer for the U.S. Geological Survey at Atlanta, Ga., has been appointed district engineer for the Survey at Montgomery, Ala., in charge of surface water investigation in Alabama and Mississippi. He recently returned from a six-month assignment to Japan evaluating the water-power resources of the country.

Alfred C. Stiefel, until lately hydraulic engineer for the Colorado Water Conservation Board at Denver, has been appointed topographic engineer in the plans and coordination division of the topographic branch of the U.S. Geological Survey in Washington, D.C.

L. W. Cook has joined in the formation of Cook and Zern, a consulting partnership specializing in the design of structural frames and foundations. Offices are in the Wabash Building, Pittsburgh, Pa.

A. V. Saph, Jr., has been appointed by Governor Warren of California as third member of the California State Board of Registration for Civil Engineers, succeeding **Mark Falk,** who resigned. Both are San Francisco consulting structural engineers.

Ellsworth W. Bassett has joined the Public Works Committee of the U.S. Senate, for which he will furnish engineering analyses and advice regarding proposed legislation. He formerly was assistant chief of the flood control division of the Office of the Chief of Engineers.

John H. Gaughan is now resident engineer for Ebasco Services, Inc., Fort Worth, Tex. He was previously with the Tennessee Eastman Corp., at Kingsport, Tenn.

J. B. Converse, consulting engineer of Mobile, Ala., and a director of the Chamber of Commerce of the United States, was recently made chairman of the organization's Committee on Education.

Charles Holbrook has left the construction plant division of the Tennessee Valley Authority to go with the engineering firm of Patchen & Zimmerman at Anniston, Ala.

Leslie G. Sumner has retired as engineer of bridges and structures for the Connecticut Highway Department after 31 years with the department. Before 1945, when he was appointed to his most recent position, Mr. Sumner was in charge of all bridge construction.

Deceased

Wilfred Atherton Clapp (Assoc. M '06) of South Weymouth, Mass., died on February 10, 1947, at the age of 77. Mr. Clapp spent his early career with the U.S. Coast and Geodetic Survey and the Metropolitan Water Works at Clinton, Mass. From 1902 until his retirement in 1938 he was in the Army Corps of Engineers, serving as superintendent of construction at Portland, Me., and San Francisco. More recently he had been stationed at the headquarters of the 6th Corps Area at Chicago.

Grover Francis Conroy (M' 30) assistant engineer for the State Railroad Commission, San Francisco, Calif., died on May 19. Mr. Conroy, who was 60, had been in the New Mexico Highway Department—for several years as state highway engineer. He had also been field representative for the Portland Cement Association in various parts of the country, and superintendent of construction for the Southern Surety Co.

Walter Wesley Gaskins (Assoc. M '20) of Port Huron, Mich., died on June 2, at the age of 58. Mr. Gaskins had been with the Cambria Steel Co., at Johnstown, Pa., and structural designer for A. L. Trout, Detroit consultant. From 1919 until recently he was on the engineering staff of Marysville, Mich., successively as engineer in charge of city development, secretary-treasurer, and city engineer.

William Adams Goff (Assoc. M. '26) consulting engineer of Philadelphia, Pa., was fatally striken in his office there on June 9. Mr. Goff was connected with the Camden, N.J., firm of Remington & Vosbury before establishing a consulting practice in Philadelphia in 1938. He designed and constructed sewer systems and water treatment plants for numerous municipalities and, during the recent war, was architect-engineer on the construction of the Valley Forge General Hospital at Phoenixville, Pa.; the Newton D. Baker General Hospital at Martinsburg, W.Va.; and the Naval Supply Depot at Williamsburg, Va.

Ulysses B. Hough (M'02) pioneer engineer and builder of Spokane, Wash., died there on May 28, at the age of 83. Mr. Hough was in charge of much early engineering construction in Spokane, and served as city engineer in 1893. For six years he was with the Bunker Hill Co., supervising construction of the Kellogg Tunnel in Idaho and acting as construction engineer on the mill. He also built the first unit of the great ore smelter at Trail, B.C., and laid out the railroad from Trail to Rossland. In later years, prior to his retirement in 1932, he was engaged in building flumes for logging.

U. B. Hough

Edward Godfrey (M'09) structural engineer for the Robert W. Hunt Co., Pittsburgh, Pa., died in a hospital there recently as the result of being struck by an automobile. Mr. Godfrey, who was 76, had been connected with the Hunt Co. for almost 50 years. A graduate of the Western University of Pennsylvania, he taught there before going to the Hunt Co.

Ralph Weller Greenlaw (Assoc. M '11) since 1930 chief engineer and treasurer of Hart & Early Co., Inc., New York City, died at his home in Teaneck, N.J., on June 26. He was 67. Mr. Greenlaw was for some years chief engineer for the Heyman & Goodman Co., of New York, on subway and tunnel construction work. He had also served as assistant division engineer on the construction of the Catskill Aqueduct.

Shirley Clark Hulse (M '14) of Bedford, Pa., died suddenly at his home there on June 18, at the age of 68. A specialist in concrete and hydraulics, Mr. Hulse spent 30 years as a field engineer on construction projects in the United States and Central and South America. His engineering reminiscences were published in the May 1944 issue of CIVIL ENGINEERING. For the past 15 years Mr. Hulse had been with the Hartley National Bank of Bedford and, at the time of his death, was president.

Charles Morris Hunter (M '22) vice-president of the Pounding Mill Quarry Corp., Pounding Mill, Va., died suddenly at his home there on June 16. Mr. Hunter, who was 71, had served four terms as a member of the Virginia House of Delegates. Before becoming connected with the Pounding Mill Quarry Corp. in 1922, he served as construction engineer for the Chesapeake and Ohio Railroad and the W. W. Boxley Co., of Roanoke, Va.

Roy Wrenshaw Jablonsky (Assoc. M. '21) highway engineer and surveyor for St. Louis County, Missouri, died in a hospital in St. Louis on June 13, at the age of 56. Mr. Jablonsky had spent most of his career with the St. Louis County Highway Department, having gone there as assistant county highway engineer in 1910. Since 1924, when he became county highway engineer, he had supervised the building of the county's hard-surfaced road system.

FARM-TO-MARKET ROADS are *two-way* trade routes. They carry food to cities; manufactured goods to farms. Important to highway officials and engineers in the development of these vital roads is Barrett-Tarvia* road tar, a dependable and economical all-purpose paving material.

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TIP TO ROAD MEN: If any of the country roads in your territory need attention, ask the Barrett field man for suggestions He can help you.

Jesse Baker Snow (M '07) chief engineer of the New York City Board of Transportation from 1934 to 1945, died in Great Neck, N.Y., on June 16. He was 79. An expert in tunnel construction, Mr. Snow was resident engineer on the construction of the Long Island Railroad and B.M.T. subway tubes under the East River in New York. During the planning of the Holland Tunnel he served as principal assistant engineer for the New York State Bridge and Tunnel Commission. He joined the Board of Transportation in 1925 as division engineer in charge of tunnel work.

J. B. Snow

John Edward August Linders (M. '23) since March 1946 chief of the engineering section, Bureau of Community Facilities, Federal Works Agency, Washington, D.C., died on June 8. Mr. Linders, who was 71, was for some years engineer of design for the Frazier Sheal Co., Cleveland, Ohio. He had also held a similar position in the Cleveland Department of Public Utilities. Later he served as chief engineer for the Public Works Administration in Cleveland and Pierre, S.Dak.

Clarence Spencer Marsh (M '45) sales engineer for the Dave Steel Co., Skyland, N.C., died suddenly there on June 20. He was 48, and a veteran of both World Wars. In the recent war he commanded the 870th Engineer Aviation Battalion, and held the rank of lieutenant colonel. Prior to the war, Mr. Marsh was for ten years civil engineer for the U.S. Veterans Administration, and he had also been with the Philadelphia Electric Co. and the Midwest Piping Co., St. Louis, Mo.

Howard Charles Paddock (M '22) of Port Washington, N. Y., died at his home there on June 25. Mr. Paddock, who was 72, retired in 1932 after many years with the Turner Construction Co., New York City. A specialist in steel and concrete structural work, he assisted in the construction of Pennsylvania Station in New York, buildings at the Brooklyn Navy Yard, and the Franklin Field Stadium in Philadelphia.

William Joseph Rowland (M '43) construction engineer of Vicksburg, Miss., died in the U.S. Veterans' Hospital in New Orleans, La., on May 21. He was 44. Mr. Rowland was a veteran of World War II, in which he served with the rank of captain. Prior to the war, he had been at the U.S. Waterways Experiment Station in Vicksburg for a number of years—most recently in the capacity of chief of the Soils Division Field.

Joel Edmond Svedlund (Jun. '46) junior engineer for the U.S. Bureau of Reclamation, Denver, Colo., died on January 28. He was 27 years old, and an alumnus of the University of Colorado, class of 1946.

Russel E. Takken (M' 44) assistant civil engineer, the Cleveland Electric Illuminating Co., Cleveland, Ohio, died suddenly on June 8. Mr. Takken, who was 57, had been with the Cleveland Electric Illuminating Co. since 1924. Prior to that, he was a designer for the Detroit Edison Co., and engineer for the Carborundum Co., Niagara Falls, N. Y. He had also been in the Army Corps of Engineers for several years.

William Bernard Ward (M '35) structural engineer of Cincinnati, Ohio, died in that city on June 6. He was 57. For 25 years Mr. Ward was on the engineering staff of Tietig & Lee, Cincinnati firm of architects. More recently he had had his own structural practice, serving as designer and builder on a number of municipal and industrial projects in Cincinnati.

Joseph Sanford William (Assoc. M. '42) for the past five years superintendent for Charles J. Spielman, Baltimore, Md., died on May 10, at the age of 48. Mr. Williams spent several years with the Maryland State Road Commission, and several years as construction superintendent for the Baltimore engineering and contracting firm of Ligon & Ligon. He had also been engineer and superintendent on the construction of several sewage-treatment plants and sewerage pumping stations in the Baltimore area.

Solomon Mark Swaab (M '03) consulting engineer of Philadelphia, Pa., died in that city on June 13, at the age of 76. In the course of 30 years' service with various municipal departments, Mr. Swaab worked on many Philadelphia improvements, ranging from the Philadelphia-Camden and Delaware River bridge projects to reclamation of the "Meadows" in South Philadelphia. As chief engineer of the Keystone Construction Co., he designed the Market Street subway and the elevated railroad line to 69th Street. He also drew the initial plans for the subway loop around City Hall and the Broad Street subway. Mr. Swaab had served as president of the Philadelphia Section of the Society.

S. M. Swaab

Roy Richard Zipprodt (M '37) consulting engineer for the American Iron and Steel Institute, New York City, died at his home in Summit, N.J., on June 20. Mr. Zipprodt, who was 57, had research experience with the Emergency Fleet Corp. and the National Bureau of Standards. From 1928 to 1936 he was in charge of all structural operations for the Portland Cement Association in New York, New Jersey, and New England, and from 1936 to 1940 was associate professor of civil engineering at Columbia University. During the recent war, he was connected with the Military Planning Division of the Office of the Quartermaster General in Washington, where he had charge of standardization and simplification.

The Engineer in Building for Peace

(*Continued from page 16*)

seldom that liberty of any kind is lost all at once." Our minds must not weakly capitulate to the cynicism which exalts national selfishness, and we must cling hopefully and faithfully to the ideals of our past, so that we shall not lose that precious liberty bit by bit.

I have dealt up to this point with engineers in building for peace, generally and idealistically. Now as to the American Society of Civil Engineers and its membership, as a part of the engineering profession, as the oldest of the Founder Societies, we should lead in bringing forcefully before the people of this country and the people of the world the knowledge that engineers must play a most important role in the revitalization of the world for peacetime pursuits and economy. Let us no longer hold ourselves within the narrow confines of a purely technical life and of purely technical thinking. Let our members provide the leadership and the financial backing within our Society so that its professional activities will be effective. Let us strike out vigorously into the tasks that are here for us to do in a manner that shall win for us the admiration and the respect of diplomats and of statesmen, as well as of the general public. We can do it. Just because we have not done it before to any great extent is no reason why we should not now resolve to take our rightful place in the thinking and in the building of a new era of peace. So long as we adhere to American ideals, remember that we stand upon the firmest foundation of any nation in the world. We can try, and we can succeed.

Papers at Duluth Discuss Vital Construction Topics

(*Continued from page 45*)

of the desired quality for the minimum cost. The more engineers and contractors respect each other and understand mutual problems, the more efficient will be their working together as part of a team.

2. The study of contract documents and procedures to keep them current with modern procedures.

3. The preparation of clear and definite specifications so that quantities can be estimated with reasonable accuracy and contractors can make close bids. The more speci-

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1. Compact cast iron measuring section—ready to place in the line.
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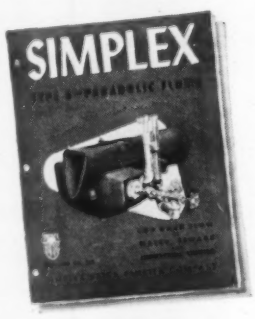

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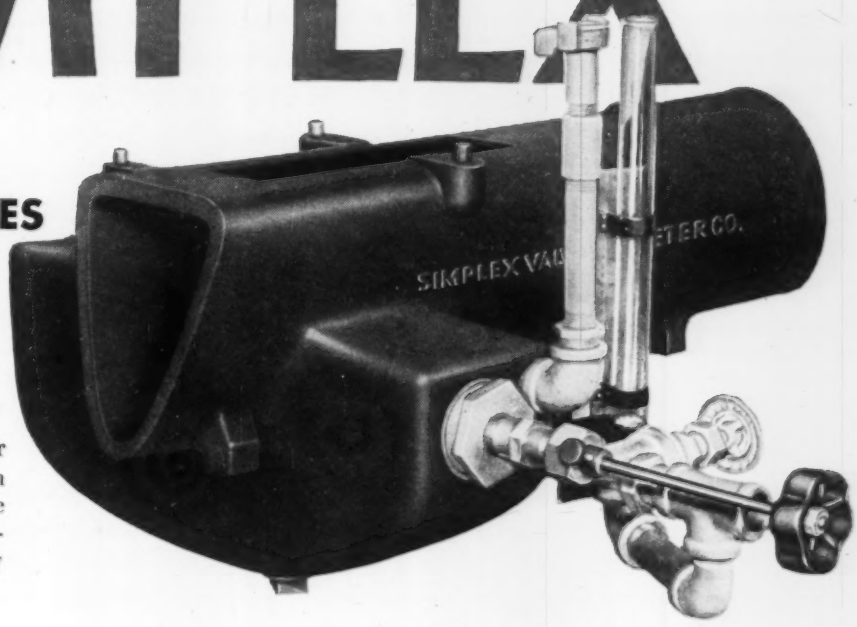

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fications are left open to the discretion or determination of the engineer, the more the contractor must add contingencies to offset unknowns.

4. The design of projects to permit economy of operation. For example, bridges can be built more economically where forms can be used repetitively.

5. The design of projects to permit use of materials that can be put in place most economically.

6. The elimination of non-essentials in plans and specifications. For example, contractors have been required to hand rub concrete surfaces when smoothness fulfilled no practical purpose.

7. The writing of specifications and requirements to permit mechanized operations to the fullest extent, so that expensive hand operations are eliminated.

8. Consultation on costs and methods of operation while projects are being designed.

Engineers designing and supervising the construction of projects should consult with responsible contractors on practical means of coordinating efficient design and economical construction methods. You will find A.G.C. contractors ready and willing to do this.

For approximately six years the start of new construction for benefit of the civilian economy has been restricted and regulated in one way or another by the federal government. During the war period the physical plant of the nation was subjected to abnormal wear and tear without normal maintenance and repair and modernization. To catch up on these deferred demands for construction is alone a big job for the industry.

Growth and expansion of the nation and development of its natural resources add other demands for new construction. Much has been learned during the past few years of new production techniques with reference to both durable and consumer goods. The more efficient production and distribution of goods requires much in the way of new facilities.

In addition science is making tremendous strides and there is the possibility that our entire mode of life may have to be altered substantially. There may develop a redistribution of industrial facilities and homes. Should this come about on a large scale, it would necessarily involve a tremendous amount of new construction.

The future of the construction industry is the future of the nation. Progress and development in the nation's future also depend greatly upon ability of the construction industry to carry out necessary work efficiently and economically. It is the responsibility of all of us in the industry to see to it that our industry does meet this need.

Proposed Projects Develop Colorado River Potentials

(*Continued from page 35*)

100,000,000 kwhr annually. Another 18,000-kw plant located on the Gunnison at the mouth of Sapinero Creek would also produce 100,000,000 kwhr annually. A 6,000-kw plant at Lake Fork near the outlet of Lake San Cristobal would produce 12,000,000 kwhr.

Davis Dam Completes Lower 550 Miles

The potential projects that have been outlined, together with the plants that exist or are under construction, make up the major part of the power resources of the Colorado River Basin. Upon completion of Davis Dam, all structures necessary to develop the feasible power heads on the lower 550 miles of the Colorado will have been built. The remaining power possibilities in the lower basin will then be Bridge Canyon, Kanab, Marble Canyon, and a few comparatively small projects on the lower tributaries of the Colorado. The resources of the upper basin have hardly been touched.

The eventual utilization of these vast resources depends on a number of things, the most important of which is a complete agreement between the states regarding the allocation of water. As previously mentioned, the Colorado River Pact apportions the water of the Colorado between the upper and lower basins, but there have been no final agreements by the states allocating the water within those two basins. If projects were built for power alone, agreements for the division of water would not be so vital. Except for the increase in evaporation resulting from the formation of reservoirs, power projects would not make consumptive use of the water in the rivers. However, it is the Bureau of Reclamation's policy to consider all of the resources of the rivers in planning its developments. Its plans for the Colorado therefore include irrigation, water for municipal uses, and river regulation, as well as for power production.

The development of the majority of these projects for irrigation purposes only would result in a cost of water which would be prohibitive. The Bureau of Reclamation, following its past practice in other regions, proposes to combine the development of the power and irrigation features to assist repayment of the irrigation costs through the application of power revenues.

Bureau of Reclamation Plan

It is essential that the development in this river system, which at best will take many years to consummate, should go forward under a comprehensive plan which considers all possibilities. Every unit of it should be critically examined to see that it properly fits into the ultimate plan. The Bureau of Reclamation is sponsoring such a plan and as the initial step has issued a report entitled *The Colorado River* which contains an inventory of projects that have thus far been investigated.

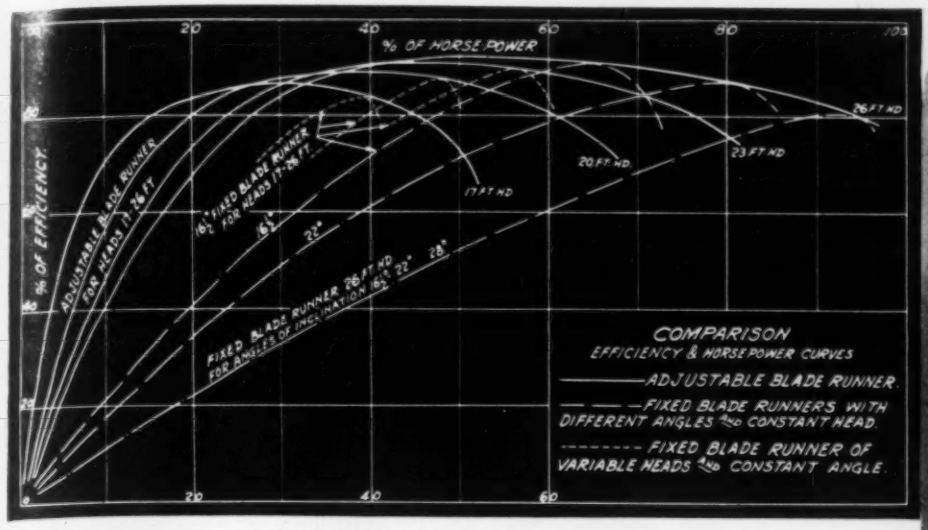
There is not enough water in the river system to develop all the irrigational possibilities that exist in the river basin. It is planned that, with the assistance and guidance of the states involved, a selection of the best of these will be made in the not-too-distant future. Following this, authorization should be sought from the Congress for the plan thus established so that the development so desirable to enhance the wealth of the nation can proceed in an orderly and expeditious manner.

Superhighway in Maine Has Latest Design Features

(*Continued from page 30*)

Sand and gravel were obtained primarily from three pits located adjacent to stations 786, 1515 and 1625 (stationing of turnpike is south to north with northern terminal at station 2300). Rock was taken from pits at stations 658 and 1625. A Cedar Rapids crusher is used at the south pit and a Pioneer crusher at the north pit, each with a capacity of 250 tons per hour. Portable plants have been set up at each pit for screening and grading of aggregates. The average length of haul for base-course aggregate is 5 miles, with a maximum of 10 miles. All coarse aggregate for the surface course was furnished from a pit at station 658.

Asphalt is delivered to the mixing plants by truck transport from Bos-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FIXED BLADE RUNNER 26 FT HD FOR ANGLES OF INCLINATION 16½° 22° 28°
26 FT. HD
23 FT. HD
20 FT. HD
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COMPARISON
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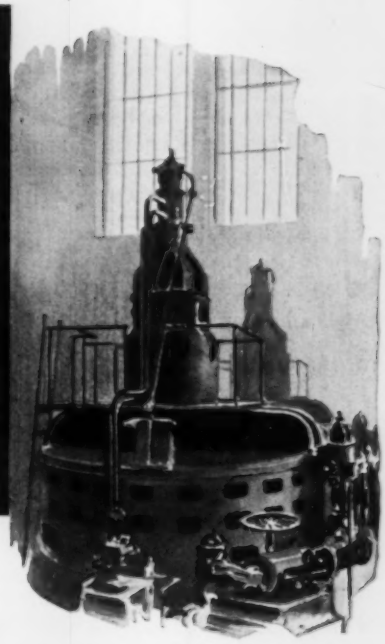
FIXED BLADE RUNNER OF VARIABLE HEADS AND CONSTANT ANGLE.



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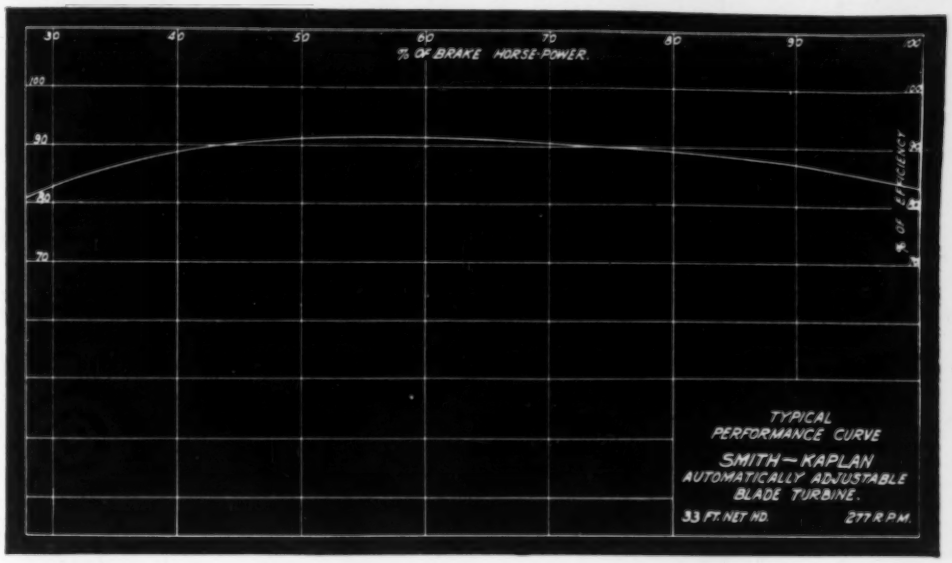

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ton, a distance of 90 miles. Asphalt-mixing plants are located at two points. For the southern half at Station 780 there are three mixers, two Barber-Greene, continuous type, each of 125-ton-per-hr capacity, and one Cedar Rapids batch-type mixer of 4,000-lb capacity. For the northern half at Stations 1400 and 1625 there are one Standard batch-type asphalt plant of 3,000-lb capacity and one Madsen batch-type asphalt plant of 4,000-lb capacity.

After mixing, the asphaltic concrete is transported to the point of placement in 2- to 4-cu-yd dump trucks. Six Barber-Greene pavers, adjustable to 8- to 12-ft widths, are employed in placing and ten Buffalo-Springfield rollers in compacting, six of tandem type and four of three-wheel type.

After paving operations are completed, gravel will be hauled in for shoulders. Shoulders will consist essentially of a compacted gravel base, the surface of which is to be treated with asphalt into which a thin layer of cover aggregate is to be rolled. Loam will be spread 4 to 6 in. over the median strip and embankment slopes and all such areas seeded.

Howard, Needles, Tammen & Bergendoff, of Kansas City and New York, designed and supervised all construction. Grading is being done by the Lane Construction Co. of Meriden, Conn., and The Savin Construction Co., Hartford, Conn. E. C. Snodgrass, of Portland, Me., is building the York River and Saco River bridges. All other bridge work is being done by the Lane Construction Co. Perini and Sons of Boston, Mass., have the contract for paving.

Survey Shows Need for $8,000,000,000 Expenditure

(*Continued from page 52*)

and improvements in the systems of 14,800 other communities. About 3,200 new water treatment plants are needed along with improvements or additions to 4,700 existing plants. More than 45,000 miles of water mains of various sizes should be built for distribution systems.

About a third of the 3.7-billion-dollar need for sewerage is for treatment works and most of the remainder for collecting and intercepting sewers. Such construction would provide more than 80,000 miles of sewers, more than 12,000 new sewage treatment plants, and additions to about 1,000 existing plants. Complete sewer systems are called for in 9,100 communities, most of them small.

Almost 50 million dollars should be spent for 12,000 trucks to collect garbage and refuse. Building of 1,090 incinerators would demand about 70 million dollars, and equipment such as bulldozers and draglines to operate 5,500 sanitary land fills would cost 25 million dollars. Land and miscellaneous expenses would require an additional 20 million dollars. Here, too, the more populous states and the largest cities have the greatest needs.

In more than 6,000,000 rural homes where water supply facilities are either wholly lacking or are unsanitary, existing supplies must be repaired or new ones, mostly wells, developed. About 1,700,000 homes require either new individual systems for disposal of household sewage or repairs to existing systems, all at a total cost of almost $400,000,000.

Construction Division Papers Highlight Duluth Convention

(*Continued from page 24*)

ments are planned wherein pulverized, magnetically concentrated ore, after beneficiation, will be mixed with peat in the pelletizing operation, forming a reasonably homogeneous pellet ideally suited for a shaft furnace for reducing iron ore. The residual shipping product of 80 to 90 percent metallic iron, compared with the 51½ percent natural iron content of current shipping ores and with the 63 percent natural iron shipping product produced by sintering magnetic concentrates, would result in freight savings of more than $37,000,000 a year, he estimated.

Use of Girder-Type Bridge Sections Affirmed

(*Continued from page 56*)

rejection of all girder sections is not a scientific solution.

I have never claimed that all girder sections are aerodynamically stable. Professor Farquharson terms my views "dangerous." I submit that the impression he conveys—namely, that the mere adoption of trusses solves the problem—is dangerous. The use of trusses does not assure stability.

In the final design for the new Tacoma Narrows Bridge, an open space or gap is left between the top chord of the truss and the outer edge of the roadway. If these outer gaps were closed, the new Tacoma section would be catastrophically unstable. However, the public and the profession are told that the stability of the new Tacoma design is credited to the wonderful discovery of the magic virtues of the truss type of construction. Years of expensive and mystifying research must be justified.

I now have plenty of tests to prove that truss sections are not unique or exceptional in their aerodynamic characteristics, and that they may be scientifically represented by equivalent girder sections of specific section-ratio.

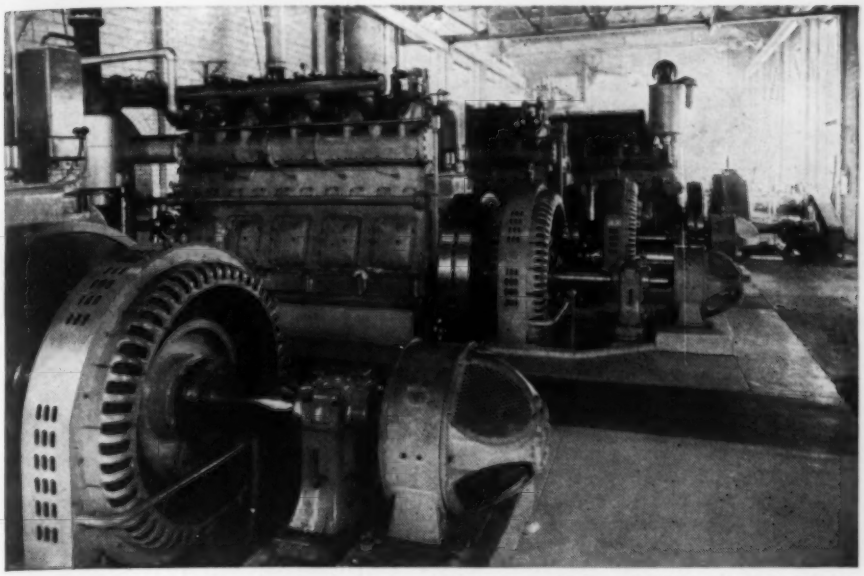
What is more, I now have girder sections of assured aerodynamic stability against vertical, torsional, and coupled oscillations at all wind velocities and at all angles of incidence. And these girder sections are of practical proportions.

There is another point on which clear thinking is required. In this subject, it is important to distinguish between aerodynamic characteristics (wind action on a section) and dynamic characteristics (elastic resistance and mass distribution). Professor Farquharson persists in confusing the two. In challenging my methods of aerodynamic analysis and diagnosis from simple wind-tunnel tests, he cites a mysterious section in which stability can be changed without altering the wind-tunnel characteristics.

There is no warrant for mystification. Such examples are easily matched. Here is one which I derived analytically and which I have publicly demonstrated: A flat plate suspended from four corner springs (spaced c from center line, $c>r$) shows coupled vertical and torsional oscillations at a precalculated critical wind velocity. Shift the points of attachment toward the center line (to make $c=r$), and the plate shows violent coupled oscillations even at very low wind velocity; the critical wind velocity is reduced to zero. Shift the points of attachment toward the center line another fraction of an inch (to make $c<r$), and the plate becomes absolutely stable against vertical, angular, and coupled oscillations at all wind velocities; the analytical expression for critical wind velocity becomes imaginary. The same effects can obviously be produced by shifting weights on the model to change r (the radius of gyration), instead of changing c. In either case, the dynamic response is changed because the *dynamic* characteristics of the section are changed. All of this is elementary, and is easily precalculated.

D. B. Steinman, M. ASCE
Consulting Engineer

New York, N. Y.



Four Worthington 4-cycle Diesel Generating Units now operating in the Shenandoah Valley Cooperative plant.

More Worthington Diesels for Shenandoah Valley Cooperative

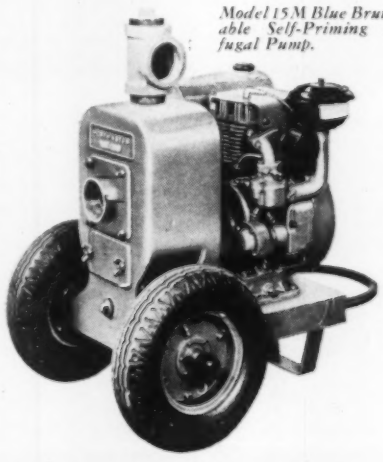
The first rural electric cooperative organization in the United States to manufacture its own current—the Shenandoah Valley Electric Cooperative, serving more than 5,200 consumers in Virginia—has a program for nearly doubling its generating capacity, and has selected Worthington equipment for the purpose.

The present sub-station and switchboard at the plant in Dayton, Virginia, will be replaced with equipment to handle about three times more voltage.

At present, the machinery that produces the electricity is driven by five Diesel engines. The present 2,300 kw generating capacity will be increased by 2,000 kw.

The original installation, in 1937, consisted of three Worthington Diesel Generator units, a 250 hp DS-3 driving a 170 kw generator, a 415 hp DS-5 driving a 285 kw generator, and a 500 hp DS-6 driving a 345 kw generator.

The load grew, and in 1939 Worthington furnished a 1,000 hp EE-8 driving a 700 kw generator. The present order calls for three 1,685 hp SEH-8 units to drive 1,180 kw generators at 360 rpm.



Model 15M Blue Brute Portable Self-Priming Centrifugal Pump.

New Portable Self-Priming Centrifugal Pump

Fast self-priming without re-circulation is the big feature of the new Blue Brute Portable Centrifugal Pumps. Most pumps of this type prime themselves by re-circulating water from the discharge side of the casing back to the impeller suction through priming ports. Blue Brute pumps have none of these troublesome devices. They prime without them.

Basically these pumps are all steel. The casings are fabricated of rust and abrasion resisting steel with smooth, streamlined internal waterways and pleasing external appearance. The impellers are cast of a hard, tough alloy iron and the casings are equipped with renewable hardened wear plates, easily replaced when they have become too badly worn. The entire unit is mounted on a rigid steel base and all sizes except the 1½"-3M rating are equipped with two pneumatic tired wheels.

Blue Brute Portable Self-Priming Centrifugal Pumps conform in all respects to the standards for this type of pump adopted by Contractors' Pump Bureau of the Associated General Contractors of America, Inc., and each unit carries an A.G.C. rating plate which certifies that the pump meets the rigid requirements that have been established. Pumps will be available in all A.G.C. ratings from 1½"-3M to 4"-40M, with larger pumps to follow later.

All pumps are equipped with air-cooled gasoline engines—single cylinder on 1½", 2" and 3" pumps and four cylinder V-type on 4" pumps.

NEWS

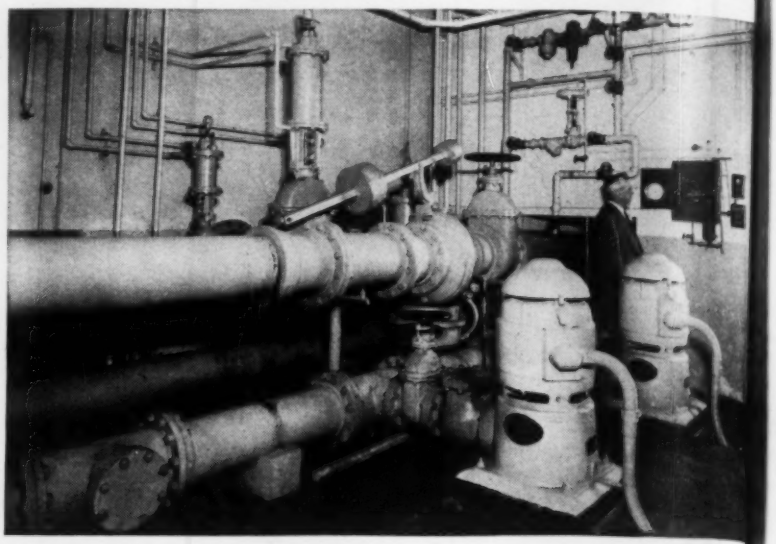
FROM THE PUBLIC WORKS FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

1

NEWS from the public works front

Two Worthington Vertical Turbine Pumps in new filter plant at Culpeper, Va.



Culpeper Pumps with Worthingtons

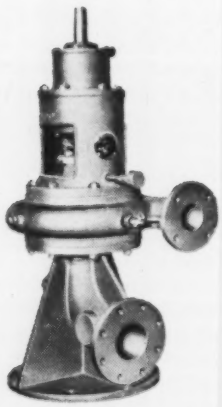
Deep well type turbine pumps furnished by Worthington carry river water to and from the new filter plant installed by the Town of Culpeper, Va.

This plant has a capacity of one million gallons per day, consisting of two one-half million gallon filter units.

The water supply is taken from Mountain Run, a stream approximately 1,000 ft. from the filter plant. A special screened intake structure in the stream permits taking all water, if necessary, during drought periods and the storing of water in the stream bed during periods when the filter plant is not in operation. A 12-in. cast-iron gravity raw water line extends from the intake to the raw water well under the ground floor of the filter building. Two raw water pumps of the deep well turbine type deliver the raw water to the coagulating or settling basins. These pumps have a capacity of 350 gpm each.

The filtered water is pumped to the distribution system and the water storage stand pipe from the clear well by two deep well type turbine pumps, each having a capacity of 350 gpm. Provision has been made for the installation of additional pumps when the water demand increases.

Worthington Centrifugal Pump for pumping sewage.

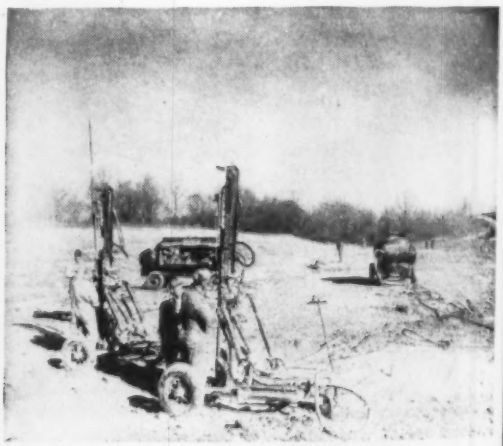


New Line of Sewage Pumps Announced by Worthington

A new line of "dry pit" centrifugal sewage pumps has been introduced by Worthington. The line consists of seven sizes for each of three types, covering the complete range of requirements. Designs have been standardized for maximum interchangeability of parts.

Features of this line include the following: renewable shaft sleeve, heavy-duty ball bearings, positive grease lubrication, non-clogging impeller, and rugged casing.

Line drawings, scale ⅜ in. to 1 in., suitable for tracing in plans, are available to consulting engineers upon request. Also descriptive bulletin W-317-B10.



Straightening Out Highway 37

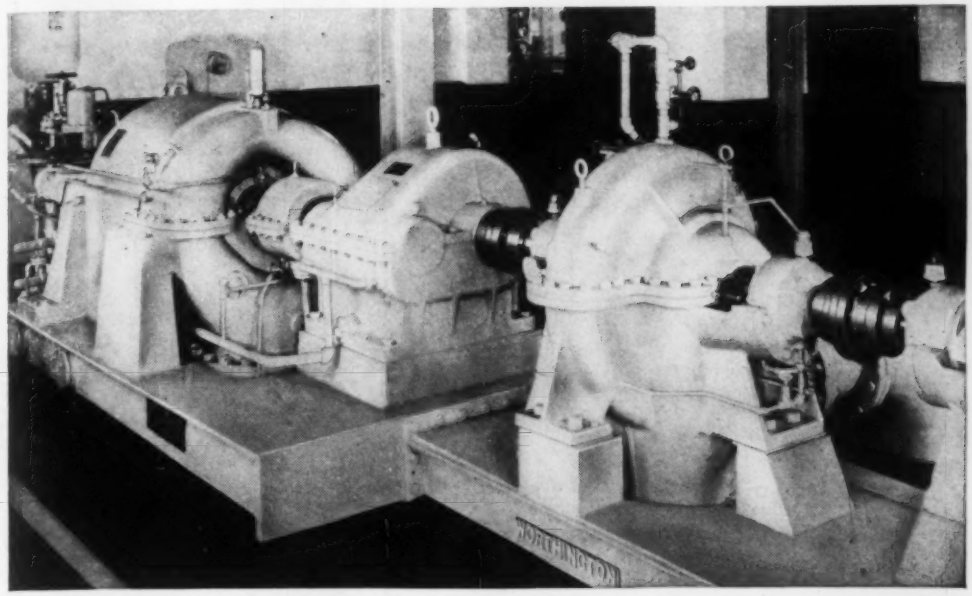
6 miles of new highway are being built between Indianapolis and Bloomington to straighten out Highway 37. The photo shows two Worthington Blue Brute UMW40 Wagon Drills being driven by two 315 cu ft Blue Brute portable compressors. The contractor is John Bloomer Construction Co., Appleton, Wisc.

public works

NEWS

Worthington Pump and Machinery Corporation

Harrison, N. J.



9 mgd Worthington Turbine Centrifugal Pump at York Water Company's pumping station installed in 1946.

30 MGD is Worthington Record at York, Pa.

One of the outstanding water works in the country is the plant of York Water Company at York, Pa., serving 22,884 connections through 169 miles of mains. The pumping station is completely equipped with Worthington pumping units.

An early pumping installation using superheated steam was made in 1915—a horizontal cross compound crank and flywheel pumping engine designed for 8 mgd against 312 ft TDH.

Two later Worthington installations were made—a horizontal cross compound crank and flywheel pumping engine rated at 5 mgd against 325 ft TDH and a turbine centrifugal unit rated at mgd against 325 ft TDH. In 1946, a second turbine centrifugal was added, rated at 9 mgd against 325 ft TDH. This unit developed a duty of 169 million ft-lb of work per 100 lb superheated steam.

Thus the present Worthington pumping equipment has an aggregate capacity of 30 mgd.

Low Pressure Turbines Power Capitol Air Conditioning

The pumps that serve the air conditioning system here are driven by Worthington-Moore Steam Turbines.

In the power plant connected with the United States Capitol and surrounding buildings Worthington-Moore steam turbines are used to drive the chilled water and condenser water pumps serving the air conditioning system.

Each of the two chilled water pump turbines is rated at 800 hp, and is equipped with separate reduction gears. The turbines operate at 4500 rpm, and the gears reduce the speed to 1450 rpm.

The condenser water pump turbines are rated at 511 hp. They operate at 4500 rpm, and gears reduce the speed to 800 rpm.

In both cases, the turbines operate on steam at 40 lb pressure and exhaust into a vacuum of 26 in.

All four turbines were installed in 1937, and they are used approximately 6 months a year, an average of 16 hours per day.

7-6

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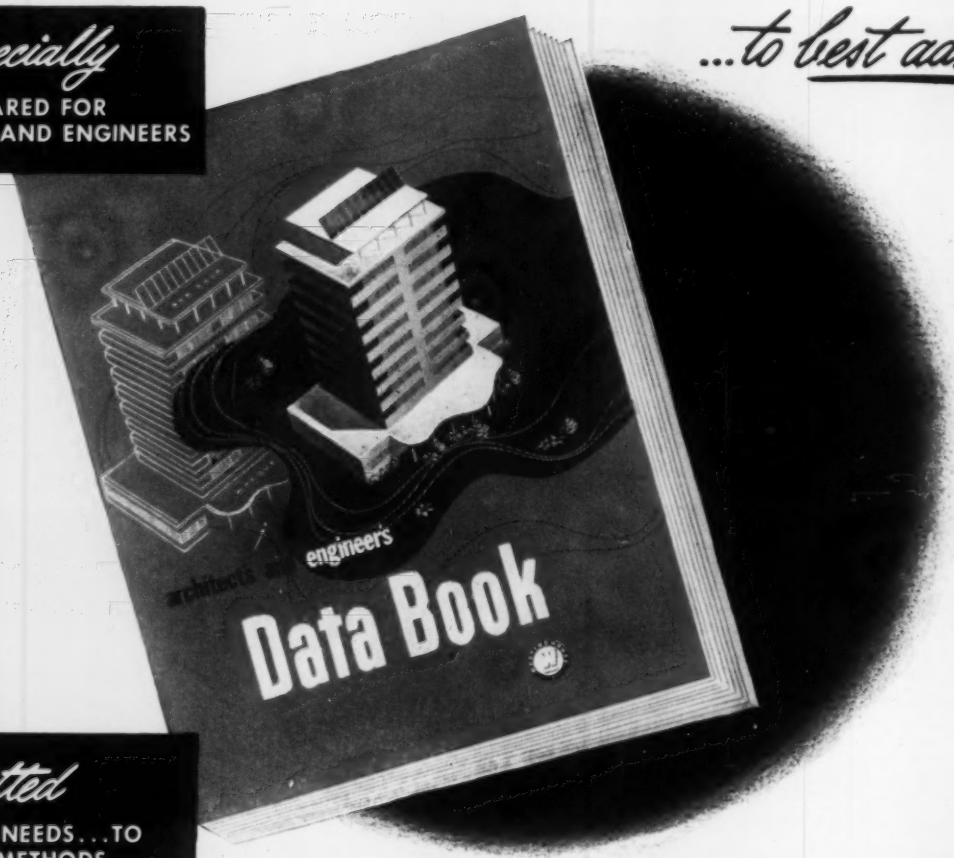

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4. **Use of smaller diameter pipe.** Transite's tight sleeve type joints are an effective safeguard against infiltration. Thus the total sewage load is reduced, which, coupled with Transite's higher flow capacity, makes possible the use of a smaller diameter pipe.

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JM PRODUCTS

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Politics Needs Engineers

(*Continued from page 47*)

atomic bomb, have recognized their tremendous responsibility to the rest of the world and have organized themselves to fight vigorously to insure the proper control of the weapon and the use of atomic energy for the benefit of mankind.

This small beginning, however, is not enough. We must all participate directly and actively, not only as good citizens, but in view of our special training and experience, as engineers, in the everyday affairs of government. In an era aptly called the Age of Science, more engineers and scientists should be in positions of leadership. Government and society have for too long tolerated an inefficiency and wastefulness that we as engineers would never countenance on engineering projects. Government, in making far-reaching decisions, has much too often been swayed and misled by selfish pressure groups and purely political considerations which are entirely foreign and unknown to the scientific and engineering methods of analysis and solution.

There is a crying need in the policy-forming government service for many more trained engineers than have to date participated.

This is a challenge to the engineer—to participate directly and actively in government and public affairs, to take direct political action to insure that his technical achievements are used and controlled for the benefit of mankind, and thus truly to fulfill his duty to society.

Merely casting your ballot is not enough to square you with your duty as a citizen. If an ignorant or bad man achieves election or a public office, do not blame him, blame yourself. He only seized an opportunity you let pass. If an intelligent or good man attains public office, it is your duty to support him against all detractors or defamers.

Experience has shown that engineers usually get into reform movements when conditions in a community get so intolerable that a crusade against the politicians in power is the only recourse. Properly handled, these reform crusades are usually successful. When the reformers win and get into power, the "rascals" are thrown out, and good government has an inning. The crusading organization usually feels that its work is done, gradually disintegrates and, at the next election the political party which was thrown out has its organization still intact, with which it gets back into power. This is why reform administrations usually last only one term. When I refer to a crusade "properly handled," it does not mean that a bureau of municipal research, a citizens' union, or a group of civic organizations would by themselves be considered "proper handling." Experience has shown that the only way to bring about a successful outcome is to have a political organization which is better organized than those of the main political parties.

At first inclination this would seem to be almost impossible of accomplishment, but experience has shown that the main political parties are not as strongly organized as they have the reputation of being. With a good cause, the proper spirit, and the ability and desire for really hard work, and with the "know-how," the task is not so difficult.

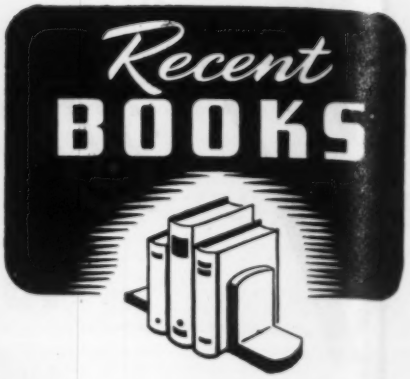
With proper unselfish leadership, you will find the majority of people anxious and willing to help in the furthering of a good civic cause. This has been proved time and time again, beyond the shadow of a doubt.

However, a simpler method than that of the crusade is for engineers to enter directly into the main political parties in order that their voices may be heard and be an influence in party policies. Along this line, former President Taft said, "However useful the independent voter may be, the existence of parties, their maintenance and their discipline, are essential to the carrying on of any popular government."

Experience has shown that organization is essential to political solutions as it is in other fields, and it therefore behooves engineers to enter political life, preferably through existing political organizations.

Perhaps we as engineers and men of science can by such action solve the human problems facing the world today as we have solved so many of its technical problems. Perhaps we, applying our scientific knowledge and methods to the conduct of government, can succeed where the statesmen and politicians have failed. In a world made one by science, perhaps we as part of the international brotherhood of men of science, disregarding national boundaries, languages, customs and traditions, can by the use of science make this truly One World—a world of true democracy, of prosperity and enduring peace.

This paper is a digest of a recent talk given by the author to the Cooper Union Alumni Association.



ACCIDENT PREVENTION ADMINISTRATION. By F. G. Lippert. McGraw-Hill Book Co., New York and London, 1947, 159 pp., illus., diagrs., charts, tables, 9¼ × 6 in., cloth, $2.25. Detailed and specific guidance is provided in each of the various functions essential to effective accident prevention. The necessary steps are presented for the organization and operation of an accident prevention program, including the collection and evaluation of data, training and follow-up procedures, union participation, policy establishment, etc. The subject is approached from the viewpoint of the persons responsible for the development, administration, and success of the program.

ANALYTIC GEOMETRY. By D. S. Nathan and C. Helmer. Prentice-Hall, Inc., New York, 1947, 402 pp., diagrs., charts, tables, 9¼ × 6 in., cloth, $3.50. The author's intent is not only to offer direct preparation for subsequent mathematical and engineering studies but also to help the student develop his ability for logical thinking. To this end, the book is so arranged that the various important aspects of analytic geometry, based on the early development of the concepts of the angle and the directed line segment, are carried respectively from the simple to the more complex treatments.

ENGINEERING, SCIENCE, AND MANAGEMENT WAR TRAINING, Final Report. By H. H. Armsby. Bulletin 1946, No. 9. Federal Security Agency, U.S. Office of Education, 161 pp., diagrs., tables, 9 × 6 in., paper, 35 cents. A brief, factual outline is presented of the origin, development, principal operating characteristics, and general results of the college-level war-training program conducted from 1940 to 1945. Part I is a narrative account of the basic principles, policies, and procedures, the contribution to the war effort, and the resulting permanent educational values. Part II sets forth in greater technical detail the authorizations, organizations, and methods of administration employed.

FILING AND INDEXING, a Study of the Principle and Practice of Classification as Applied to Filing Systems. O. W. Roskill & Co. (Reports) Ltd., London, S.W.1 (14 Great College St.), England, 1946. 169 pp. plus appendices, 8 pp., tables, 14 × 9⅛ in., paper, £2, 2s. Following a brief discussion of the purpose of filing, this useful study presents simple methods of classification by name or subject, including cross-reference arrangements. Approximately the middle half of the work is devoted to detailed description of the major classification systems (Dewey Decimal, Library of Congress, etc.) now in general use. Both the simple and extensive systems of classifications are critically analyzed with respect to their use in particular circumstances and for various kinds of material. Information is also given on the physical equipment for filing and on the management of files.

(THE) FUTURE OF HOUSING. By C. Abrams. Harper & Brothers, New York and London, 1946. 428 pp., illus., tables, 9½ × 6 in., cloth, $5. This comprehensive and up-to-date study discusses fully the question of home ownership and home building, the operation of the real estate and construction industries, and the conflict between government control and private interests. In the final section, the author proposes a program for housing reform, including specific aims, planning procedures, and necessary agencies.

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(*Continued on page 100*)

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ANAYA, MARVIN (Assoc. M. '47) Civ. Engr., Bureau of Eng. Dept. of Public Works, City Hall, San Francisco, Calif.

ANDERSON, ROBERT ARCHIBALD KENNETH (Jun. '47) Draftsman, Acme Ornamental Iron Works, 1327 Rainier Ave. (Res., 3229 Thirty-first Ave. West), Seattle 99, Wash.

ARNOLD, ALTON DAVIS (Assoc. M. '47) Asst. Project Mgr., Thompson & Street, Gen. Contr., Box 393, Beaufort, S.C.

ASCHNER, ULRICH FELIX (Jun. '47) Calle 35 No. 17-21, Bogota, Colombia, S.A.

BAILEY, JOE KASEY (Assoc. M. '47) Topographic Engr., U.S. Geological Survey, 107 Old Post Office, Chattanooga, Tenn.

BANDY, ALVA HARLAN (Jun. '47) Civ. Engr., State Highway Comm., Masonic Temple, Topeka (Res., Cottonwood Falls), Kans.

BECHERT, CHARLES HAROLD (M. '47) Director, Div. of Water Resources, State Dept. of Conservation Underwriters Bldg., Indianapolis, Ind.

BERKEY, JAMES HENRY (Assoc. M. '47) Constr. Engr., Public Works Office, Potomac River Naval Command, Naval Gun Factory, Washington 25, D.C. (Res., 429 North Park Drive, Arlington, Va.)

BOLAND, JOHN VINCENT, JR. (Jun. '47) (John V. Boland Constr. Co.), 2715 Dalton Ave., St. Louis 9, Mo.

BOOTH, LOUIS FREDERICK (M. '47) George A. Fuller Co., 597 Madison Ave., New York 22, N.Y.

BOTERO-HOYOS, ARTURO (Jun. '47) Engr., Central Hidroelectrica de Caldas (Res., Carrera 19, No. 22-29), Manizales, Colombia, S.A.

BUFORD, ROBERT STROTHER (Jun. '47) Designer, Bridge Dept., Chesapeake & Ohio Ry. Co., 1001 First National Bank Bldg. (Res., 1511 Hanover Ave.), Richmond 20, Va.

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BURROUGHS, ISAAC LUMPKIN (Jun. '47) Civ. Engr., Tennessee Valley Authority, 415 Union Bldg., Knoxville, Tenn.

CABANISS, WILLIAM FREDERICK EVE (M. '47) Engr.-Constr., Bureau of Reclamation, Customs House (Res., 315 Marion St.), Denver, Colo.

CHICK, FRANK HEWES (Assoc. M. '47) Cons. Engr. (Frank H. Chick), 1916 Monroe St., Pinehurst, Wash.

CHERRY, BAYRON EMILE (Assoc. M. '47) Civ. Engr., Tennessee Valley Authority, 710 Pound Bldg., Chattanooga, Tenn. (Res., Box 458, Decatur, Ala.)

CLARY, WILLIAM CRAIG (Assoc. M. '47), Associate Bridge Engr., State Dept. of Highways, 1221 East Broad St. (Res., 2002 Foxcroft Rd.), Richmond 21, Va.

COYLE, ROBERT WILLIAM (Jun. '47) Partner-Sales Engr., Geo. P. Coyle & Son, 412 Park St., Jacksonville 4, Fla.

CRIMMINS, ROBERT (Assoc. M. '47) Secy., Thomas Crimmins Contr. Co., 624 Madison Ave., New York 22, N.Y.

D'AMELIO, JOSEPH HORACE, JR. (Jun. '47) Junior Designer, Philadelphia Plant, Link-Belt Co., 2045 Hunting Park Ave., Philadelphia (Res., 631 Penfield Ave., Havertown), Pa.

DARBY, WILTON BROWN (Assoc. M. '47) Civ. Engr., Memphis Natural Gas Co., Sterick Bldg., Memphis, Tenn.

DE LA SAYETTE, EMMANUEL RENE (Jun. '47) Engr.; 5 rue Laval, St. Cloud (Seine et Oise), France.

DE SOUCY, ALLAN CHARLES (Assoc. M. '47) Office Engr., Monsanto Chemical Co., Unit 5, Miamisburg (Res., 153 Potomac St., Dayton 10), Ohio.

DOAK, ROBERT (Jun. '47) Civ. Engr., U.S. Bureau of Reclamation (Res., 1150 Acoma), Denver 4, Colo.

DWYER, JOHN JOSEPH (M. '47) Cons. Engr., 65-39 Seventy-eighth St., Middle Village, N.Y.

ELLER, CLYDE BLAINE (Jun. '47) San. Engr., Cowley County Joint Health Dept., 106 1/2 East East 9th St. (Res., Box 455), Winfield, Kans.

EROL, DEMIRHAN (Jun. '47) 73 Kucuk Camlica Yolu, Kisikli, Istanbul, Turkey.

FALLWELL, FRANCIS XAVIER (Jun. '47) Office Engr., State Highway Dept., 4700 Drexel Drive (Res., 5919 Richmond Ave.) Dallas, Tex.

FENG, TSUAN HUA (Assoc. M. '47) Grad. Student, Univ. of Wisconsin (Res., 312 Breeze Terrace), Madison, Wis.

FISCHMAN, LEON HENRY (M. '47) Merchandise Man, Penobscot Shoe Co., 210 Lincoln St., Boston, Mass.

FONG, ISIDRO (Jun. '47) P.O. Box T1, Colon, Panama.

FOUST, CLARENCE T. (Assoc. M. '47) Civ. Engr., U.S. Engr. Office, P.O. Box 59, Louisville, Ky. (Res., 20 Cromwell Rd., Greenhills, Cincinnati 18, Ohio.)

FRAMKI, KAVSI KAIKHOSROU (Assoc. M. '47) Director, Indian Waterways Experiment Station, Govt. of India 1, Byramjee Jeejeebhoy Road (Res., 17, Elphinstone Road, Camp), Poona 1, India.

FULLARTON, HUGH ALEXANDER (Assoc. M. '47) Senior Engr., Public Works Dept. (Res., 36 Kand St., Karori), Wellington, New Zealand.

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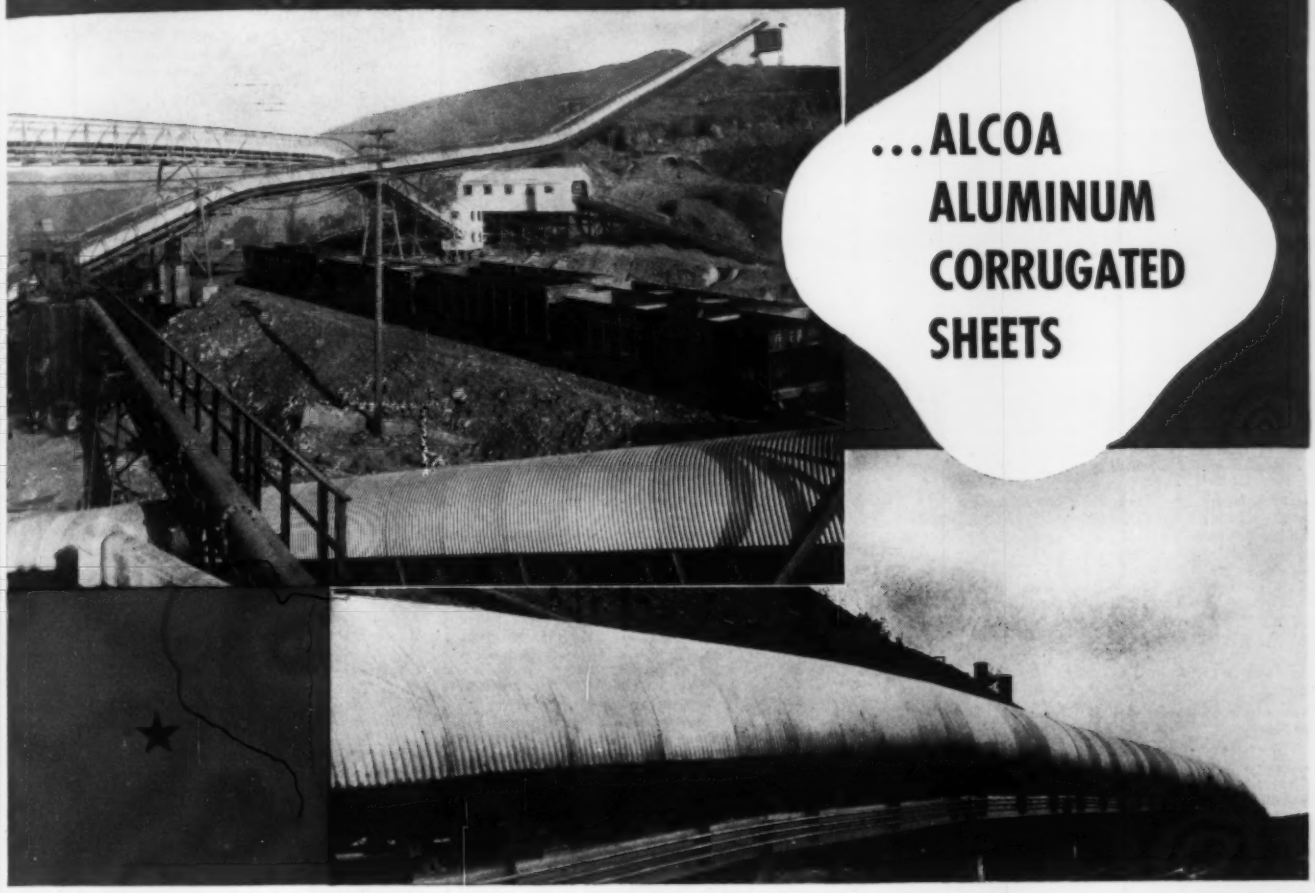

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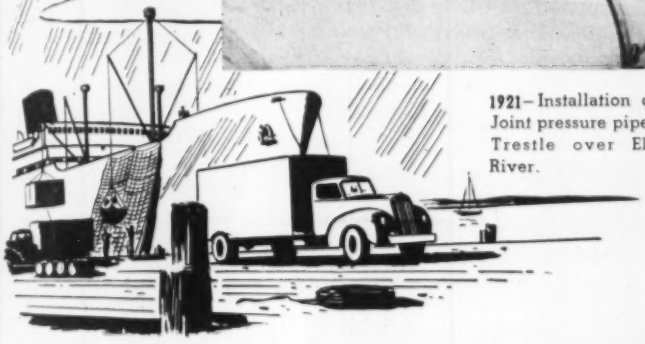
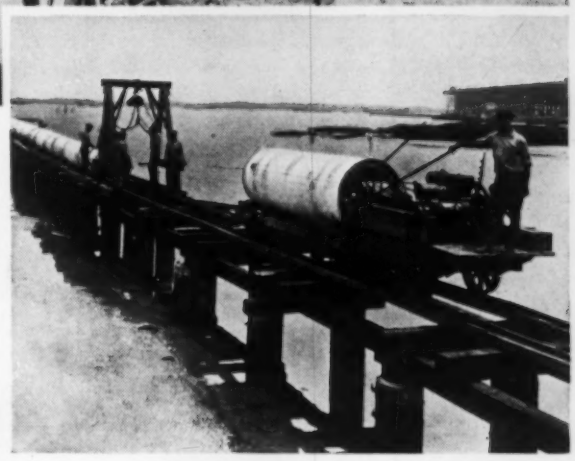


1921 – Installation of Lock Joint pressure pipeline on Trestle over Elizabeth River.



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Reinstatements

BARNES, WILLIAM WRIGHT, JR., Assoc. M., Dist. Sales Engr., Star Mfg. Co. of Oklahoma, 30 North Raymond Ave., Pasadena 1, Calif., readmitted Jan. 13, 1947.

BAUGH, LAWRENCE MARION, Assoc. M., Gen. Mgr., The Baugh Co. (Res., 3403 Thirty-eighth, S.W.), Seattle 6, Wash., reinstated June 18, 1947.

BROWN, WILLIAM JOSEPH, Jun., Instr., Dept. of Mechanics, Univ. of Delaware, Newark, Del. (Res., 250 East Main St., Elkton, Md.), reinstated June 18, 1947.

FORREST, KYLE, Assoc. M., Chf. Engr., Empire Harriet St. (Res., 2360 Chestnut St., Apt. 315), San Francisco, Calif., reinstated June 27, 1947.

JOHNSON, STANLEY LATHROP, Assoc. M., Asst. Res. Engr., Parsons, Brinckerhoff, Hogan & Macdonald, 142 Maiden Lane, New York, N. Y. (Res., 250 East Main St., Elkton, Md.), readmitted May 19, 1947.

LEFEBVRE, WILLIAM CLAYTON, Assoc. M., 26 East Montery St., Phoenix, Ariz., reinstated June 9, 1947.

POTTER, JOHN CLAUDE, JR., Jun., Lt. Col., Corps Engrs., U.S.A., Care, PMS & T, Univ. of Illinois, Urbana, Ill., reinstated June 13, 1947.

RUSSELL, ALEXANDER DAVID, Assoc. M., Structural Engr., State Packing Corp., 101 California St., San Francisco (Res., 1653 Belvedere Ave., Berkeley 2), Calif., readmitted May 19, 1947.

Resignations

CLAYMAN, HERBERT SIDNEY, Jun., 1631 Sixteenth, Apt. 103, Seattle 22, Wash., resigned June 16, 1947.

EVANS, HOWARD TASKER, M., 14 Wabon St., Wellesley 81, Mass., resigned June 24, 1947.

GRISWOLD, FREDERICK FAY, M., 22 Elm St., Summitt, N.J., resigned Mar. 10, 1947.

LAFORCE, HARRY BERNHARD, Jun., 208 West Washington St., Room 1501, Chicago, Ill., resigned May 15, 1947.

MARTINSON, NORMAN LEWIS, Jun., Public Works Office, U.S. Naval Gun Factory, Washington 25, D.C., resigned May 16, 1947.

STRADLING, REGINALD EDWARD, Assoc. M., Ministry of Works, Lambeth Bridge House, London S.E. 1, England, resigned May 16, 1947.

STRUDWICK, FRED NASH, JR., Jun., 237 Camden Ave., Salisbury, Md., resigned May 19, 1947.

SUNDSTROM, HARALD JOSEPH, Assoc. M., 1660 East Hyde Park, Chicago 15, Ill., resigned Dec. 31, 1946.

VICTOR, FRED SAMUEL, JR., Jun., 1516 Jennings Ave., Bartlesville, Okla., resigned June 13, 1947.

WOODBURN, RUSSELL, Assoc. M., Assoc. Agri. Engr., Soil Conservation Service, State College, Miss., resigned May 15, 1947.

APPLICATIONS FOR ADMISSION OR TRANSFER

August 1, 1947 Number 8

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid it in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board. Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years
Associate Member	Qualified to direct work	27 years	8 years	1 year
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years

APPLYING FOR MEMBER

ALLEN, TOM JOHNSON (Assoc. M.) (Age 60) Associate Engr., City of San Diego, Calif.

AMES, CARL LLOYD (Age 40) Archt., Milwaukee, Wis.

ANDERSON, WILLIAM JOSEPH (Age 59) Highway Consultant (loaned to War Dept.), PRA, Berlin, Germany.

APPEL, THEODORE BURTON, JR. (Age 42) Chf. Engr., C. S. Johnson Co., Champaign, Ill.

ASHTON, FRANK WILLIAM (Assoc. M.) (Age 39) Engr. P-6 (Eng., Rock Island Dist., Corps of Engrs.) Davenport, Iowa.

AXLINE, EDWIN JASPER (Assoc. M.) (Age 44) Engr. (Civ.), U.S. Bureau of Reclamation, Billings, Mont.

BARRETT, CECIL HEWINS (Age 50) Asst. to Chf. Engr., Dept. of Public Works, Pittsburgh, Pa.

BECK, LAWRENCE THOMAS (Age 46) Member of firm, Lawrence T. Beck & Co., Dallas, Tex.

BLOUT, EDWIN ALLAN (Age 43) Engr. P-5, U.S. Bureau of Reclamation, Washington, D.C.

CASS, ALFONSO CARL (Age 40) Regional Engr., Reconstruction Finance Corporation, Washington, D.C.

CAUFIELD, WALLACE BURNSIDE (Assoc. M.) (Age 55) Dist. Representative for United Kingdom and Iceland, Caterpillar Traction Co., Paddington, London, England.

CLARK, DONALD LINDER (Age 36) Public Works Officer, Naval Training Center, San Diego, Calif.

COTTON, JAMES ARNOLD (Assoc. M.) (Age 37) Engr. in Chg., Ft. Worth Suboffice, Galveston Dist., Corps of Engrs., Fort Worth, Tex.

CRIST, MARION LOWELL (Assoc. M.) (Age 43) Cons. Engr., Marion L. Crist & Associates, Little Rock, Ark.

DARLING, JAMES ARTHUR (Assoc. M.) (Age 46) Civ. Engr. P-6, Special Eng. Div., Panama Canal, Diablo Heights, Canal Zone.

DAVIDSON, JOHN EICHHORN (Age 44) Vice-Pres., J. A. Jones Constr. Co., Inc., Oak Ridge, Tenn.

DERBY, RAY LYLE (Assoc. M.) (Age 49) Senior San. Engr., Los Angeles Dept. of Water & Power, Los Angeles, Calif.

DONOVAN, THOMAS LEROY (Age 49) Project Engr., A. Duarty Constr. Co., Caracas, Venezuela.

DORITY, ALEC OUSLEY (Age 43) Cmdr., USNR, Arlington, Va.

FINNEY, EDWIN ASHLEY (Assoc. M.) (Age 48) Prin. Research Engr., Michigan Highway Dept., East Lansing, Mich.

FOSSETT, GEORGE LEONARD (Age 38) Civ. Engr., Gulf Research & Development Co., Sewickley, Pa.

FOSTER, LORRAN (Age 49) Senior Engr. with Sverdrup & Parcel, St. Louis, Mo.

FOWLER, THOMAS JOSEPH (Age 50) Partner, Fowler-Veranth Constr. Co., St. Paul, Minn.

FRASER, LELAND BERTRAM (Age 43) Vice-Pres., Fraser-Brace Eng. Co., Inc., New York City.

FREEMAN, RALPH, JR. (Age 36) Partner, Freeman, Fox & Partners, London S.W. 1, England.

GALLOWAY, GERALD EDWARD (Age 44) Dist. Engr., Little Rock Dist., Corps of Engrs., Little Rock, Ark.

GATEWOOD, ANDREW WARWICK (Age 66) Director of Public Works and City Engr., Town of Pulaski, Va.

GIRAND, JOHN GOODMAN (Assoc. M.) (Age 41) Member of firm, Johannessen & Girand, Phoenix, Ariz.

GUYER, ERNEST L. (Age 60) City Civ. Engr., New Castle, Ind.

HALLAND, HENRY NORTON (Age 47) Chf. Design Engr., Harza Eng. Co., Chicago, Ill.

HARVEY, ADDISON REESE, JR. (Assoc. M.) (Age 47) Prin. Civ. Engr., Alabama Highway Dept., Montgomery, Ala.

HERZFELD D., GERMAN ADOLFO (Age 47) Chf. Engr., Machinery Sec., Ministry of Public Works, La Paz, Bolivia.

HILLMAN, ERNEST CHRISTIAN, JR. (Age 38) Partner, Hillman & Nowell, Structural Engrs., Los Angeles, Calif.

HUSBAND, HENRY CHARLES (Age 38) Member of firm, Husband & Co., Cons. Civ. Engrs., Sheffield, England.

IRVINE, JOHN WOODWARD (Age 44) Asst. Plant Engr., Newport News Shipbuilding & Dry Dock Co., Newport News, Va.

KELLY, EDMONDE BERNARD (Assoc. M.) (Age 37) Area Mgr., Berkeley Area, Atomic Energy Comm., Berkeley, Calif.

KENDRICK, HARRY DECKARD (Assoc. M.) (Age 49) Superv. Engr., Defense Plant Corporation (subsidiary, Reconstruction Finance Corporation), Chicago, Ill.

LEAS, A. ROBERT (Age 42) Fuel Storage Project Mgr., Bureau of Yards & Docks, Navy Dept., Washington, D.C.

LEVAN, FLOYD ERNEST (Age 51) Senior Archtl. & Civ. Engr., E. I. du Pont de Nemours & Co., Wilmington, Del.

LINDMAN, BERTRAM HERMAN (Assoc. M.) (Age 40) Highway Specialist, American Automobile Association, Washington, D.C.

MCKAY, ALFRED JESSE, JR. (Age 43) Head Civ. Engr. Saxe, Williar & Robertson, Cons. Engrs., Baltimore, Md.

MCKEAN, JAMES PERCIVAL (Assoc. M.) (Age 45) Prof. of Gen. Eng. and Director Iowa State Coll., Camp Dodge Annex, Des Moines, Iowa.

MCKINNON, DONALD ARTHUR (Age 51) Pres.

USERS REPORT ON THE "CATERPILLAR" BULLDOZER!

IT'S A HIT! NO ADDITION TO THE "CATERPILLAR" LINE HAS WON HIGHER PRAISE THAN THE NEW "CATERPILLAR" BULLDOZER. HERE ARE A FEW SAMPLES OF THE WAY USERS FEEL ABOUT IT:

From Walter O'Neill, contractor, Havre, Montana

"Unquestionably it's the best and last word in 'dozers. The ability to tilt the blade enables doing lots of work that would previously have required an angledozer. We moved 9000 cubic yards in 5 days this past week. This 'dozer beats any we know of."

From N. M. Whilden, contractor, Dallas, Texas

"I've made no adjustments to this unit in 3 months, where formerly on other equipment adjustment was necessary every day."

From Harry Sandora, D7 operator, Conn.

"With the D7 and the 'Caterpillar' Bulldozer blade I can walk these 2-foot stumps right out of the ground."

From Jim Calas, farm contractor, Lakeview, Oregon

"Since running it a month, am more glad than ever I waited. It does everything a fellow could ask. The 'dozer handles nice and easy and accurate."

From S. T. Lambeth, Greensboro, N. C.

"Best darn 'dozer I've ever owned or seen operated. Visibility is perfect; blade extremely rugged and durable; dirt seems to roll from the blade instead of sticking to it; blade reacts very quickly to the controls and it will dig harder material than any other 'dozer of comparable size on the market."

From R. H. Byles, lumberman, Fresno, Calif.

"This outfit is rugged. It's the best dirt-moving 'dozer I've seen."

From John Gaston, Main Roads Commission, Queensland, Australia

"I think the 'Caterpillar' 'dozer is the best and most easily controlled of any I have handled. Driving a D7 with 'Caterpillar' 'dozer attached, I loaded 1980 yards of earth in 8½ hours."

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MARCEAU, JULES P. (Age 35) Dist. Mgr., Southern Canada Power Co., Actonvale, Quebec, Canada.

MARTIN, JOHN GARDNER (Age 43) Structural Engr., Portland Cement Association, Lansing, Mich.

MORGAN, BENJAMIN ARTHUR, JR. (Assoc. M.) (Age 43) Constr. Engr., Celanese Corporation of America, Zacapu, Mich., Mexico.

MOTA, CANDELARIO CALOR (Age 49) Prof. of Civ. Eng., Mayaguez, Puerto Rico.

NEVE, HENRY LYNN (Age 46) With U.S. Bureau of Reclamation, Denver, Colo.

PINCUS, SOL (Assoc.M.) (Age 54) Senior San. Engr., Dept. of Health, New York City.

RIDDLE, CARSON (Age 41) Senior Civ. Engr., U.S. Navy, Bureau of Yards & Docks, Bremerton, Wash.

ROSENBERG, LYLE (Age 46) Senior Engr. and Res. Mgr., Sverdrup & Parcel, Cons. Engrs., San Francisco, Calif.

ROSENTHAL, LIONEL HAROLD (Age 51) Senior Civ. Engr., City of Portland, Ore.

SAHINAN, GEORGE FREDOLF (Assoc. M.) (Age 46) Chf. Designing Engr., State Water Conservation Board, Helena, Mont.

SCOTT, HENRY CLARKSON (Assoc. M.) (Age 45) Vice-Pres. and Treas., Caldwell & Scott, Inc., New York City.

SHELTON, MERCEL JOSEPH (Assoc. M.) (Age 41) Asst. Mgr. and Engr., La Mesa, Lemon Grove and Spring Valley Irrigation Dist., Le Mesa, Calif.

SHEPHERD, GEORGE EDWARD (Assoc. M.) (Age 45) Res. Engr., Fort Sill Project Office, Tulsa Dist., Corps of Engrs., Fort Sill, Okla.

SIMON, LOUIS IRWIN (Age 59) Architectural Engr. (private practice), Chicago, Ill.

SKELTON, RUSSELL ROY (Assoc. M.) (Age 50) Associate Prof., Dept. of Civ. Eng., Univ. of New Hampshire, Durham, N.H.

SMITH, ARBA MORRIS (Age 40) Head, Specifications & Estimates Sec., Corps of Engrs., Tulsa, Okla.

SMITH, MORTIMER WILSON, JR. (Age 56) Engr., The Public Service Comm. of West Virginia, Clarksburg, W.Va.

STARK, HUGO JULIUS (Age 42) Engr., Superhighway Div., Cook County Highway Dept., Chicago, Ill.

STEARNS, DAVID WHITAKER (Age 54) Asst. Engr., Corps of Engrs., Portland, Ore.

THOMAS, EDWARD HARPER (Assoc. M.) (Age 40) Bridge Plans Engr., Montana Highway Comm., Helena, Mont.

TIMBY, ELMER KNOWLES (Assoc. M.) (Age 41) Prof., Dept. of Civ. Eng., Princeton Univ., Princeton, N. J.

TRAINOR, CHARLES FRANKLIN (Age 40) Head Engr., U.S. Engr. Office, Savannah, Ga.

VAN HORN, EMERY LAMARTINE (Assoc. M.) (Age 39) Area Mgr., Atomic Energy Comm., Bellport, N.Y.

VANONI, VITO AUGUST (Assoc. M.) (Age 42) Associate Director, Hydraulic Structures Laboratory, California Inst. of Technology, Pasadena, Calif.

WALLACE, JAMES NICHOLAS (Assoc. M.) (Age 40) Senior Sales and Service Engr., Tar Products Div., Koppers Co., Inc., Point Pleasant, W.Va.

WELLS, CARLOS KENYON (Age 42) Div. Engr., Water Dept., Long Beach, Calif.

YARROW, JOSEPH RICHARD (Age 43) Chf. Engr., Airways Eng. Consultants, Inc., Washington, D.C.

APPLYING FOR ASSOCIATE MEMBER

ALTMAN, HENRY (Jun.) (Age 30) Civ. Engr., Corps of Engrs., War Dept., San Francisco, Calif.

ANDERSEN, CEDRIC HERBERT (Age 37) Chf. Engr., Summegbell Roof Structures, Berkeley, Calif.

ANDRUS, FREDRICK MARIAN (Jun.) (Age 35) Senior Plan Checker, Dept. of Bldg. & Safety, County of Los Angeles, San Gabriel, Calif.

BADER, JOHN ADOLF (Jun.) (Age 31) Field Engr. and Constr. Supt., Armco Drainage & Metal Products, Inc., Baltimore, Md.

BARENTINE, ELBERT HAMILTON (Age 34) Associate Engr. with Post Engr., Camp Polk, La.

BAYLES, CHARLES CLIFFORD (Jun.) (Age 35) Cons. Engr., Eugene, Ore.

BERNARD, WOODROW (Age 34) Civ. Engr. P-3, Atomic Energy Comm., Oak Ridge, Tenn.

BOEHL, ELMO WILLIAM (Age 39) Engr., Process Engrs., Inc., Dallas, Tex.

BREWER, JOHN STUART (Age 36) Designing Engr., American Steel & Wire Co., Duluth, Minn.

BROWN, HERSCHEL BAST (Age 49) Civ. Engr., Bureau of Eng., Los Angeles, Calif.

CARBONELL, MARTIN (Age 46) Head of Revetment & Dredging Secs., War Dept., Corps of Engrs., New Orleans, La.

CHEVES, CECIL LANGDON (Jun.) (Age 35) Project Mgr., Daniel Constr. Co., Greenville, S.C., Port Wentworth, Ga.

COLLIER, WILLIAM PRESCOTT (Jun.) (Age 35) Field Engr. and Stockholder, Gen. Eng. Co., Inc., Seattle, Wash.

COOPER, GEORGE B. (Age 42) Project Engr., Montana Highway Dept., Great Falls, Mont.

COULTER, FORREST HARMON (Age 40) Eng. Aide, U.S. Bureau of Reclamation, Logan, Utah.

ESTES, WARREN CLOUGH (Age 32) Owner, E. & T. Constr., Co., Inglewood, Calif.

EVERETT, ELVIN LESLIE (Age 36) Asst. Civ. Engr., TVA, Fountain City, Tenn.

FARRELL, JOSEPH ROMULUS, JR. (Age 27) Officer in firm, Joseph R. Farrell, Inc., Bldg. Constr., Philadelphia, Pa.

FISHER, VOIGT RAYMOND (Jun.) (Age 34) Civ. Engr., P-2, Dept. of Agriculture, SCS, Nucla, Colo.

FLORES, AMBROSIO RIMANDO (Age 39) Asst. Engr. to Chf. Engr., Manila Engr. Dist., Manila, Philippine Islands.

GALLAGHER, CHARLES RICHARD (Jun.) (Age 32) Traffic Eng. and Traffic Planning Consultant, Ventura, Calif.

GOEHRING, FRANK ELDON (Age 35) Office Engr. (P-4), Bureau of Reclamation, Deschutes Project, Bend, Ore.

GOODWIN, RAY (Age 46) Asst. Head, Specifications and Publications Sec., Canals Div., U.S. Bureau of Reclamation, Denver, Colo.

GREEN, JOSEPH (Age 32) Design Engr., National Lead Co., New York City.

HALL, ARTHUR STANLEY (Age 30) Head Teacher of Civ. Eng., Sydney Tech. Coll., Willoughby, N.S.W., Australia.

HIGHTOWER, CHARLES LEE, JR. (Jun.) (Age 32) Bridge Designer, South Carolina Highway Dept., Columbia, S. C.

HOWE, WARNER (Jun.) (Age 28) With Gardner & Howe, Structural Engrs., Memphis, Tenn.

HUDDLESTON, PAUL MCKISSON (Jun.) (Age 32) Chf. Structural Engr. and Associate, Reynolds, Smith & Hills, Engrs. and Archts., Jacksonville, Fla.

KARKKAINEN, ARVID RICHARD (Age 37) Engr. (Civ.), U.S. Bureau of Reclamation, Pierre, S. Dak.

KATRAK, SOLI KEKHUSHRU (Age 30) Lecturer in Civ. Eng., Coll. of Eng., Poona, Bombay, India.

KIRWAN, LOUIS PATRICK (Age 28) Contractor's Engr., Gilbert Ash, Ltd., London, England.

KRISHNAMURTHY, NARASIMHA (Age 29) Graduate student, Harvard Graduate School of Eng., Cambridge, Mass.

LANCE, ODIS PAUL (Age 37) Cons. Engr., Civil and Mining, Coquille, Ore.

LANGDALE, FREDERICK DARROW (Jun.) (Age 31) Bridge Design Engr., State Highway Dept., Olympia, Wash.

LARSEN, RALPH PETER (Age 46) Chf. Civ. Engr., Way & Structures Dept., Milwaukee Elec. Ry. & Transport Co., Wauwatosa, Wis.

LATIF, ABDUL (Age 33) Executive Engr., Public Health Dept., Govt. of Bengal, India, on leave for graduate study at Harvard Univ.

LESHER, CARL EUGENE, JR. (Age 35) San Engr., H. K. Ferguson Co., Cleveland, Ohio.

LITCHFORD, JAMES OUSBY (Age 36) Instructor and graduate student, North Carolina State Coll., Raleigh, N.C.

MACDOUGALL, CEDRIC HUGH (Age 46) Asst. Engr., in charge of design, Dept. of Water and Sewerage, Parsons, Brinckerhoff, Hogan & MacDonald, New York City.

MARINER, HOBART GRAHAM (Jun.) (Age 33) Specifications Engr., Stanolind Pipe Line Co., Tulsa, Okla.

MOTZ, JOHN ROBERT (Age 45) Civ. Engr. III, TVA, Elizabethton, Tenn.

OLTMANNS, ELMER FRED (Age 38) Senior Engr., Kimberly-Clark Corporation, Neenah, Wis.

PARRATT, LYLE FRANKLIN (Jun.) (Age 33) Constr. Supt., Atlantic Gulf & Pacific Co., Manila, Philippine Islands.

PATTERSON, CHARLES BIRD (Jun.) (Age 32) Engr. (Civ.), P-5, Waterways Experiment Station, Vicksburg, Miss.

PEACOCK, EARL GEORGE (Jun.) (Age 33) Office Engr., Kaiser Engrs., Inc., Fontana, Calif.

PEARL, EMANUEL HILLEL (Age 36) San. Engr. (P-4) Western Ocean Div., Corps of Engrs., Sausalito, Calif.

PEAVEY, FRANK HARRIS (Jun.) (Age 34) Gen. Supt., Raymond-Morrison-Knudsen, Vitoria, Espirito Santo, Brazil.

PRATT, ALBERT SAMUEL, JR. (Age 28) Structural Designer with Ellis Wing Taylor, Archt. and Structural Engr., Los Angeles, Calif.

RANKIN, JOHN WILSON (Age 29) Asst. Designer, Braithwaite, Burn & Jessop Constr. Co., Ltd., Calcutta, India.

REEVE, JOHN ORSON (Jun.) (Age 35) Civ. Engr. (private practice), Pomona, Calif.

ROGERS, GLENN HERBERT (Jun.) (Age 35) Archt. Engr. (P-4), Real Estate and Legal Div., Public Works Office, U.S. Navy, Oakland, Calif.

ROGERS, LOTT TOWNSEND (Age 37) Engr., Hq. AMC, Wright Field, Osborn, Ohio.

RON, SANTIAGO HERNANDEZ (Age 37) Chf. Dept. of Coordination & Control, Ministry of Public Works; also Vice-Pres., Coll. of Engrs. of Venezuela, Caracas, Venezuela.

ROUBAL, EDWARD FRANK (Age 27) Draftsman, Harrop Ceramic Service Co., Columbus, Ohio.

RUNYAN, MARVIN WILLARD (Age 29) Designer, Stevens & Koon, Portland, Ore.

SATTEM, IVAN (Age 32) Engr., New York State Power Authority, Brooklyn, N.Y.

SAXTON, NORTON EDGAR (Age 34) Civ. Engr., Prof. 3 Grade 1, Corps of Engrs., Joliet, Ill.

SCHAEFER, EDWARD JOSEPH (Age 41) Hydr. Engr., Ground Water Div., U.S. Geological Survey, Columbus, Ohio.

SHIPMAN, ROY MARVIN (Jun.) (Age 30) Special work for T. C. Forrest, Cons. Engr., Three Rivers, Tex.

SHIVLER, JAMES FLETCHER, JR. (Jun.) (Age 29) San Engr., Reynolds, Smith & Hills, Jacksonville, Fla.

SITAPATHI, NANNILAM RAMACHANDRA IYER (Age 30) Prof. of Civ. Eng. and Head of Dept. of Civ. Eng., Coll. of Eng., Cocanada, Madras.

SMYTHE, JAMES FREDERICK (Age 34) Constr. Engr., Ebasco Services Inc., New York City.

SNELL, JOHN RAYMOND (Jun.) (Age 34) San Engr., China San. Eng. Service; present address, Melrose, Mass.

SPADA, JOHN ANTHONY (Age 42) Clearance Inspector, M. of W. Dept., New York Central R.R., New York City.

SPENCER, ERNEST LINCOLN (Jun.) (Age 34) Asst. Prof. of Civ. Eng., Northeastern Univ., Boston, Mass.

STEPHENS, PERRY (Age 38) Res. Engr., Robert & Co., Inc., Archts. and Engrs., Atlanta, Ga.

SWEET, WILLIAM HERBERT (Age 38) Engr., Bureau of Reclamation, Montevista, Colo.

TAN, ENG JOO (Jun.) (Age 27) Chf. Engr. and Managing Director, E. J. Tan Eng. Co., Ltd., Singapore.

THOMAS, CHARLES WELDON (Jun.) (Age 34) Flood Control Engr., SCS, U.S. Dept. of Agriculture, San Fernando, Calif.

TOBEY, FRANK THRALL, JR. (Jun.) (Age 29) With H. B. Hunter, Engr., Memphis, Tenn.

TUFTE, EDWARD E. (Age 35) Design Engr., City of Phoenix, Ariz.

VAN ATTA, WARD HAMILTON (Age 33) Executive Officer to Army Engr., First Army, Omaha, Nebr.

WANNONI LANDER, LUIS (Jun.) (Age 32) Chf. Engr., Div. of San. Eng., Ministry of Health, Caracas, Venezuela.

WEINER, DANIEL JEANNOT (Jun.) (Age 33) Engr. Consultant to Hadassah Medical Organization, Jerusalem, Palestine.

WHERRY, JOHN ELWOOD (Age 30) Instructor, Applied Mechanics Dept., Kansas State Coll., Manhattan, Kans.

WOLF, HERBERT CHARLES (Jun.) (Age 33) Associate Engr., Russell & Axon, Cons. Engrs., Affton, Mo.

YOGI, MAILLACHERUVU VENKATESWARA (Age 32) Asst. Comdr. Royal Engrs., Mil. Engr. Services, Deccan, India.

ZAPP, LLOYD OTTO (Jun.) (Age 33) Asst. Div. Civ. Engr., Humble Oil & Refining Co., Corpus Christi, Tex.

APPLYING FOR JUNIOR

ANDERSON, ROBERT WILLIAM (Age 26) Designer, Ganteaume & McMullin, Engrs., Beverly, Mass.

CAMPBELL, CHARLES CLEVELAND, JR. (Age 27) Marshall & Brown, Archts. & Engrs., Kansas City, Mo.

FOSSUM, GUILFORD OLE (Age 28) Asst. Prof. of Civ. Eng., Univ. of North Dakota, Grand Forks, N.Dak.

HOROWITZ, GEORGE FRITZ (Age 23) Asst. with O. Weinberger, Civ. Engr. & Gen. Bldg. Contr., Shanghai, China.

ISMEN, ISMAIL (Age 24) Engr. with Gahagan Constr. Co., and Byrne Organization, Cedarhurst, Md.

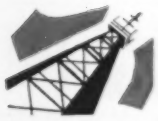
LIGUORI, FRANK ROBERT (Age 28) Walton, N.Y.

MANOHAR, MADHAV (Age 23) Supervisor, Design & Test Div., PWD, Madras, India; at present in U.S. on design and test for Ramapadasagar Dam, Denver, Colo.

MARTIN, JOHN PIERRE (Age 26) Instructor, Univ. of Washington, Seattle, Wash.

MORRIS, PAUL EDWARD (Age 30) With U.S. Engr. Office, War Dept., Kansas City, Mo.

OKAMOTO, GEORGE TAKEO (Age 27) Jun. Civ.



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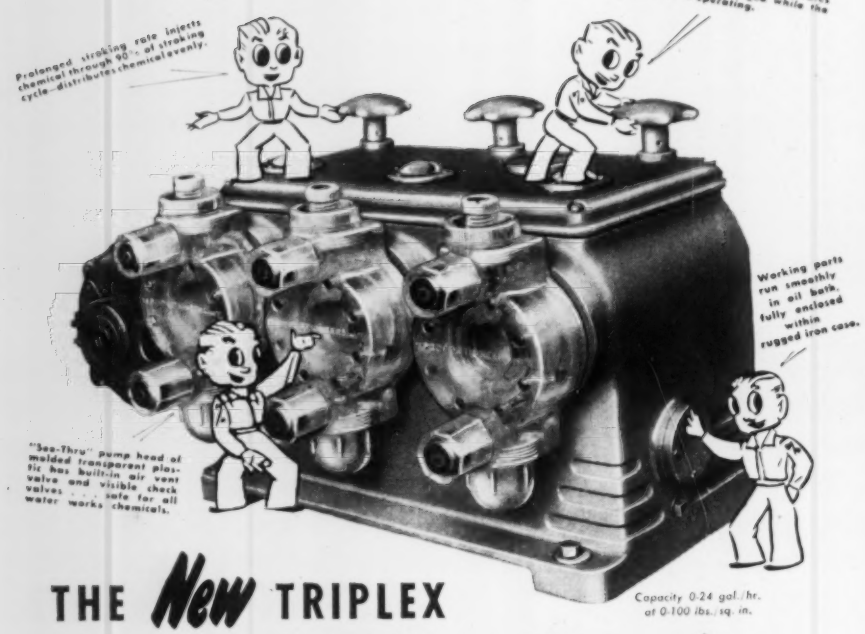
Prolonged stroking rate injects chemical through 90° of stroking cycle—distributes chemical evenly.
By a turn of the knobs, the feeding rates may be selected and changed while the Chem-O-Feeder is operating.
Working parts run smoothly in oil bath, fully enclosed within rugged iron case.
"See-Thru" pump head of molded transparent plastic has built-in air vent valve and visible check valves . . . safe for all water works chemicals.
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Engr. P-1, Territorial Airport System, Dept. of Public Works, Honolulu, Hawaii.

RICE, PAUL FREDERICK (Age 26) Graduate student, Massachusetts Inst. of Technology, Boston, Mass.

SIEWERT, MARTIN FREDERICK (Age 29) Asst. to Field Engr., Allen N. Spooner & Son, New York City.

THORNBURN, THOMAS HAMPTON (Age 31) Research Associate in Civ. Eng., Univ. of Illinois, Urbana, Ill.

VOLLMER, ALBERTO JOSE (Age 21) Graduate Student, Rensselaer Polytechnic Inst., Troy, N.Y.

WAH, THEIN (Age 28) Graduate student, Univ. of Utah, Salt Lake City, Utah.

ALA. POL. INST.

CLANTON, WILLIAM RALPH, 1947 (27)
HOUSE, ALBERT RICHARD, JR., 1947 (27)

UNIV. OF ARK.

FRAUENTHAL, JULIAN MAURICE, 1947 (27)
GLASGOW, FRANK REED, JR., 1947 (29)
GRAY, LAWRENCE C., 1947 (24)
RAGSDALE, JOHN GAILS, JR., 1947 (22)
RANKIN, WARREN HARVEY, 1947 (23)
SMITH, NATHAN EUGENE, 1947 (24)

BROOKLYN POL. INST.

MILLMAN, STANLEY MARVIN, 1947 (20)

BROWN UNIV.

SHOGREN, VINCENT EUGENE, 1947 (22)

BUCKNELL UNIV.

GADINIS, MICHAEL CHARLES, 1947 (29)

CALIF. INST. TECH.

BENNETT, DUDLEY EARL, 1947 (23)

CATHOLIC UNIV. OF AMERICA

CORASANITI, JOSEPH VICTOR, 1947 (24)
CURLEY, LAWRENCE JOHN, JR., 1947 (23)
KINGSBURY, HENRY LEWIS, JR., 1947 (23)

UNIV. OF CIN.

BUETTNER, PAUL EDWARD, JR., 1947 (24)
HOPKINS, ALLEN VINTON, 1947 (28)
KNOCH, DONALD ROBERT, 1947 (25)

THE CITADEL

CAUSEY, MALCOLM LANDER, JR., 1947 (23)
RAY, WILLIAM LUTHER, JR., 1947 (25)
WADDELL, JAMES MADISON, JR., 1947 (24)

CLARKSON COLL. TECH.

HUBBELL, ALLEN WILLIAM, 1947 (24)
JEROME, WILLIAM BARKER, 1947 (24)
LOWERS, BENJAMIN PAUL, JR., 1947 (23)
MAGGI, MICHAEL ORAZIO, 1947 (24)
RICHERT, ROBERT CHARLES, 1947 (21)

CLEMSON A. & M. COLL.

SCHUMACHER, SNEAD, 1947 (23)

COLO. A. & M. COLL.

KOONSMAN, GEORGE LEE, 1947 (24)
SMITH, EDWARD CLINTON, 1947 (26)

UNIV. OF CONN.

ESCHERT, ERNEST, JR., 1947 (24)
GRISWOLD, HAYDEN LEAVENWORTH, JR., 1947 (25)

COOPER UNION

BLUMBERG, HAROLD, 1947 (24)
CHLETSOS, ARGYRIOS PANTELIS, 1947 (27)
DELVERS, FRANK, 1947 (28)
LEVY, ROY, 1947 (25)
MARRA, PETER STANLEY, 1947 (29)
SMITH, LEWIS VAN ALYN, 1947 (24)
VERITY, FREDERIC JAMES, 1947 (24)

CORNELL UNIV.

HAGAN, WILLIAM LYON, 1947 (26)
HUTTER, JACK ALBERT, 1947 (22)
KIPNIS, EUGENE AARON, 1947 (22)
LANNOM, EDWARD HICKS, JR., 1946 (23)
LOUCKS, ROBERT DEAN, 1947 (22)
MATTHIES, FREDERICK JOHN, 1947 (21)

DARTMOUTH COLL.

ALDOM, ROBERT SADLER, 1947 (24)
BYRKIT, EDMUND JOHN, 1946 (22)
CLARK, FLETCHER, III, 1947 (24)
SMITH, VICTOR COLLINS, JR., 1947 (23)

UNIV. OF DEL.

CLARK, WILLIAM FLETCHER, III, 1947 (25)

DUKE UNIV.

BULLARD, JOHN CARSON, 1947 (21)
CREDLE, EDWARD CECIL, 1946 (20)
FERDINAND, THOMAS FRANCIS, 1947 (24)
HANEY, JOHN NORMAN, 1947 (23)
HOKE, GEORGE CLAYTON, 1947 (26)
MURFF, JAMES THEO, 1947 (24)
STAPP, MAURICE QUINTON, JR., 1947 (21)

UNIV. OF FLA.

FINK, ABRAHAM IRA, 1947 (22)
RICHARDSON, JAMES EVERETTE, 1947 (24)

GA. SCHOOL TECH.

FREEBORN, JOHN BERTRAM, 1947 (22)
WOOD, JAMES IVY, 1947 (24)

GEORGE WASHINGTON UNIV.

DOE, FREDERICK HENRY, JR., 1947 (33)

HARVARD UNIV.

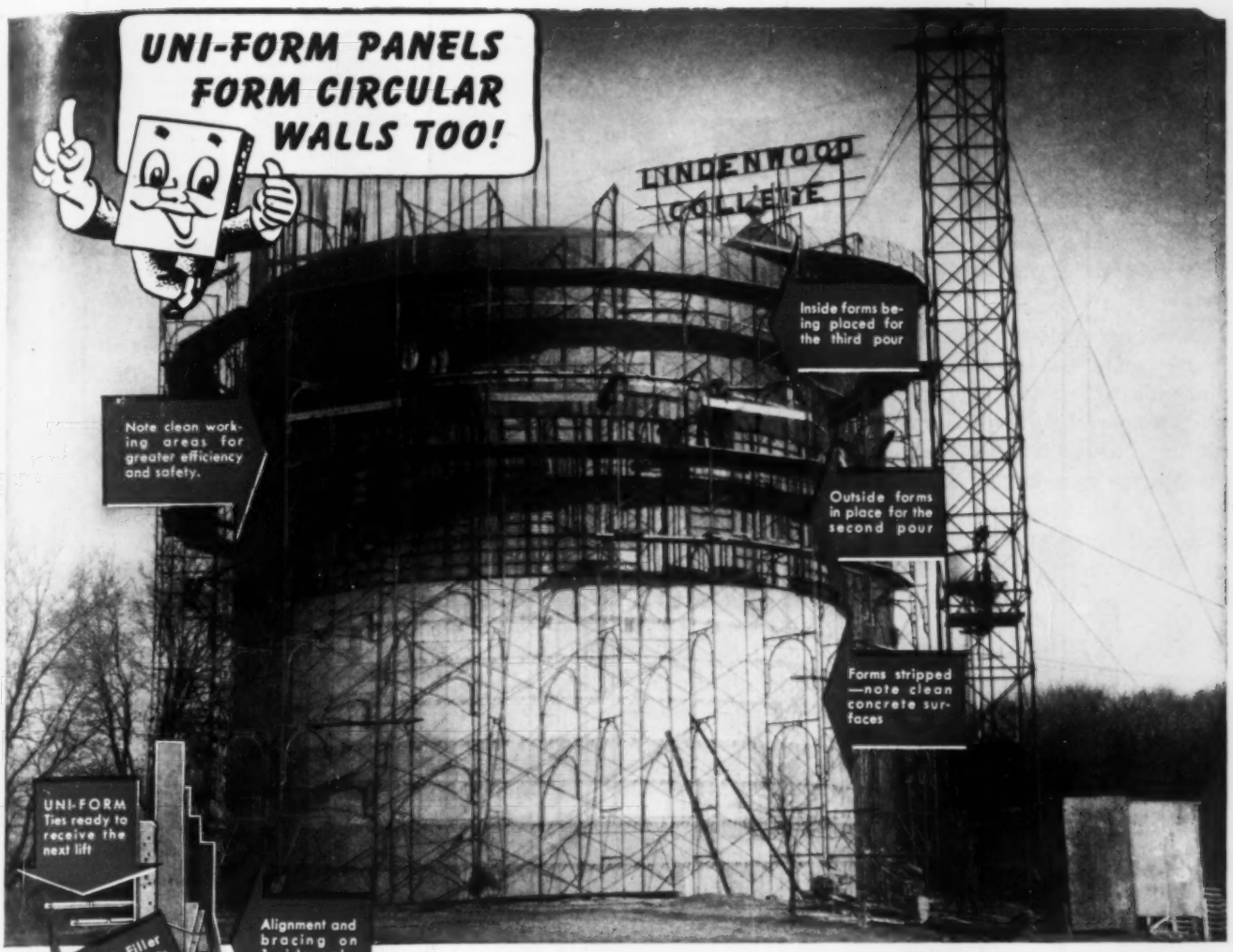
AMORY, WALTER, 1947 (22)
ANTENEN, JAY FREDERICK, 1947 (24)
BECKMAN, WALLACE JENNINGS, 1947 (24)
BORRERO, PEDRO MANUEL, 1947 (26)
CORSO, JOSE MARIA, 1947 (24)
DUKE, JESSE CHISHOLM, 1947 (31)
FARRELL, VINCENT BERNARD, 1947 (26)
FITZGERALD, JOHN EDMUND, 1947 (23)
KAPP, MARTIN SEYMOUR, 1947 (23)
MCBRIDE, IAN FARQUHARSON BOYD, 1947 (24)
MCDANIEL, WILLIAM KENNEDY, 1947 (24)
MCLENDON, SAMUEL CHENEY, 1947 (24)
NELSON, JAMES CLARK, 1947 (21)
ROLSTON, JACK WILLIAM, 1947 (25)
RUBENSTEIN, SEYMOUR, 1947 (29)
STILES, WILLIAM SUMNER, 1947 (23)
THOMPSON, JAMES BERNARD, 1947 (25)
WATSON, ROBERT GEORGE, 1947 (29)

UNIV. OF IDAHO

BARNES, MERRILL ELDON, 1947 (25)
CHRISTENSEN, JAMES PHILIP, 1947 (27)
COOK, JOHN CAREY, 1947 (30)
HALL, JOHN IVAN, 1947 (29)
OSLUND, GEORGE RUSSELL, 1947 (25)
PEEBLES, JOHN JOSEPH, 1947 (26)
ROSS, FRANK ELMER, JR., 1947 (29)
WASHBURN, HARVEY CURTIS, 1947 (29)

ILL. INST. TECH.

BENJAMIN, IRWIN ARTHUR, 1947 (22)
FLORYAN, JOHN EUGENE, JR., 1947 (24)


UNI-FORM PANELS FORM CIRCULAR WALLS TOO!
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Inside forms being placed for the third pour
Note clean working areas for greater efficiency and safety.
Outside forms in place for the second pour
Forms stripped —note clean concrete surfaces
UNI-FORM Ties ready to receive the next lift
Special Filler Panel compensates for increasing circumference
Alignment and bracing on 1 side only.
Contoured waler required on 1 side only.

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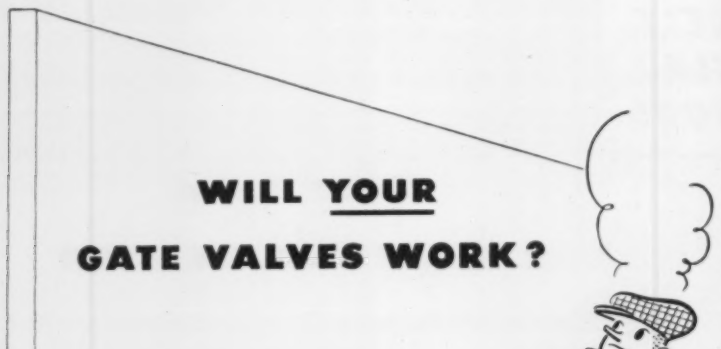

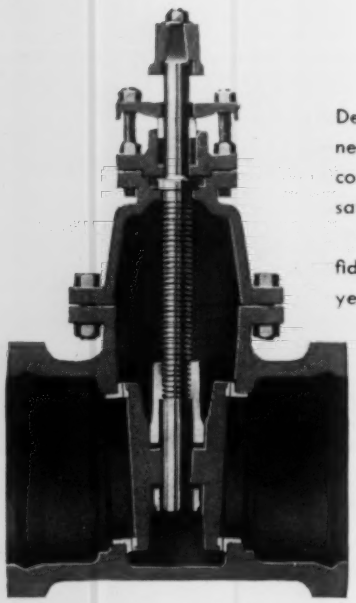

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The R. D. Wood Gate Valve has earned high confidence, having proved itself over a span of many years, and under conditions of every sort. It is so designed that practically nothing *can* go *wrong*. Just 3 internal parts—a spreader and two discs. No pockets to collect sediment. The discs move clear of the seats before being lifted into the bonnet, permitting unobstructed flow. Turning freely on the trunnions, they are not liable to wear at any *one* place—wear is distributed, life prolonged. In closing, the spreader action is *at the center* of the discs, seating them tight and even, and preventing leakage. One of the fine compliments paid this gate valve is the fact that waterworks engineers often *specify* it—as an extra margin of safety. Give your community the *plus* protection of R. D. Wood Gate Valves.

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Hawry, Henry Joseph, 1947 (22)
Larimer, John Murray, 1947 (26)
Miller, Lavern Archie, Jr., 1947 (22)
Obert, David Louis, 1947 (28)
O'Geary, Dennis Traylor, 1947 (22)
Seeger, John Carl, Jr., 1947 22)

UNIV. OF ILL.

Allensworth, William Burton, 1947 (24)
Atkinson, Matthew John, 1947 (24)
Autrey, William Stanley, 1947 (22)
Barcus, Chauncey Harold, 1947 (25)
Bare, Elmer Edward, 1947 (24)
Bear, Joseph Thomas, Jr., 1943 (26)
Brandt, Paul Carl Henry, 1947 (23)
Briggs, Oliver Howard, Jr., 1947 (21)
Clancy, Raymond Edward, 1947 (20)
Cohn, Norman Kenwood, 1947 (25)
Conant, John Heywood, 1947 (26)
Crowe, Bazel Ernest, 1947 (23)
Curtis, William Austin, 1947 (21)
Fago, Charles Raymond, 1947 (23)
Fischer, Ned Emil, 1947 (24)
Fishback, Jesse Leroy, 1947 (28)
Fitch, Vernon, 1947 (27)
Fitton, Bertron Reed, 1947 (24)
Friese, Northam Billups, 1947 (24)
Gates, Robert Rudolph, 1947 (25)
Goepfert, Benjamin Leroy, 1947 (27)
Gourlie, Norman Temple, 1947 (29)
Hammersmith, John William, 1946 (28)
Hoodwin, Herbert Jonathan, 1947 (26)
Hornkohl, George Robert, 1947 (27)
Kampf, Anton, 1947 (33)
Kimmons, Robert Lee, Jr., 1947 (21)
Kohl, Chester Clarence, 1947 (29)
Kolb, Harold Herbert Henry, 1947 (30)
Krug, Robert Frederick, 1947 (27)
Kulick, Peter, 1947 (22)
Lanning, Lyle Edgar, 1947 (25)
Leek, John Ries, 1947 (22)
Logan, Jack McEwen, 1947 (26)
Lyddon, John William, 1947 (25)
Martinez, Alvaro, 1947 (21)
Newmark, Herbert Leonard, 1947 (21)
Pasternak, Raphael Anthony, 1947 (22)
Pattison, Robert Karl, 1947 (25)
Perry, James McKinley, 1947 (21)
Randolph, William Abbott, 1947 (23)
Reimers, Frederick Holberg, Jr., 1947 (21)
Seiden, Uriel, 1947 (21)
Schmitz, Elmer Rollin, 1947 (27)
Smith, Townsend Boughton, 1947 (20)
Springman, Aloysius James, 1947 (25)
Stallmeyer, James Edward, 1947 (20)
Thomas, Thomas Lawrence, 1947 (29)
Walker, Bobbie Philbrick, 1947 (27)
Warnock, Thomas Henry, 1947 (21)

STATE UNIV. OF IOWA

Qureshy, Asrar Ahmad, 1947 (24)
Sangster, William McCoy, 1947 (21)

KANS. STATE COLL.

Conwell, Leo Roy, 1947 (30)
Dewey, Thornton Cornell, 1947 (27)
Johnson, Edgar Burton, 1947 (24)
Nelson, Edwin Lee, 1947 (30)
Parrish, Loris Nelson, 1947 (26)
Paulson, Frank George, 1947 (27)

LAFAYETTE COLL.

Forss, Hendrick Alexander, 1947 (23)
Scott, Herbert James, 1947 (27)

LEHIGH UNIV.

Mecklem, William Millard, 1947 (28)
Whipple, Robert Sterrett, 1947 (23)

LA. STATE UNIV.

Easley, Cleon Ellis, Jr., 1943 (24)

UNIV. OF LOUISVILLE

Graham, Thomas Carlisle, 1947 (20)
Hollis, William Joseph, Jr., 1947 (20)
Larkin, Joseph Willard, 1947 (21)
Wenzel, Robert Carl, 1947 (21)
Wilson, John Douglas, 1947 (27)

MANHATTAN COLL.

Baigas, Joseph Frederick, Jr., 1947 (23)
Blaine, Eugene Joseph, 1947 (26)
Bodine, William David, 1947 (24)
Castro, Alex Joseph, 1947 (22)
De Leo, Edward Bruce, 1947 (22)
Fox, Albert Joseph, 1947 (22)
Fox, Arthur Joseph, Jr., 1947 (23)
Gannon, John Joseph, 1947 (23)
Hennelly, Edmund Paul, 1947 (24)
Hughes, Edward James, 1947 (25)
Layer, Joseph William, Jr., 1947 (25)
Luciano, Anthony Michael, Jr., 1947 (25)
Marchese, Paul T., 1947 (24)
Moriarty, Lawrence Robert, 1947 (30)
O'Brien, David John, 1947 (22)
O'Connell, Camillus Aquinas, 1947 (24)
Riverso, Raphael Gino, 1947 (23)
Rowan, Anthony Thomas, 1947 (25)
Schul, Charles William, 1947 (25)
Tanner, Donald Norman, 1947 (23)
Troiano, Robert Charles, 1947 (23)
Williford, Robert Elliott, 1947 (24)
Wilson, Harry Dennis, Jr., 1947 (28)

MARQUETTE UNIV.

Michaud, Emil Theodore, 1947 (27)

MICH. STATE COLL.

Snow, Arthur William, 1947 (28)

UNIV. OF MICH.

Batchelder, Francis Joseph, 1947 (25)
Bradley, Robert Orin, 1947 (25)
Breidenbach, Victor Rudolph, 1947 (32)
Cott, Samuel Morris, 1947 (25)
Dmytryk, John Robert, 1946 (21)
Donnelly, Paul Joseph, 1947 (28)
Heimbach, Clinton Louis, 1947 (26)
Main, Curtis Verner, 1947 (22)
Mammel, Fredrick Arthur, 1947 (24)
Peacock, Robert Holden, 1947 (21)
Rabe, Robert James, 1947 (24)
Rigotti, Robert Andrew, 1947 (22)
Romeo, John Salvatore, 1947 (22)
Rusche, Fredric, 1947 (26)
Shanabery, Robert Fowler, 1947 (27)
Sharpe, Roland Leonard, 1947 (23)
Snell, Robert Emerson, 1946 (23)
Van Eyck, Marvin Rowan, 1947 (23)

UNIV. OF MINN.

Jarvis, Alice Mary, 1947 (21)
Samuelson, Colin Frithiof, 1947 (23)

MO. SCHOOL OF MINES & MET.

Andrews, John Avery, 1947 (30)
Boyd, Darald Dane, 1947 (24)
Carlton, Paul Fleming, 1947 (23)
Galavis, Hely Jose, 1947 (24)
Henning, Paul, 1947 (22)
Henry, George Edward, 1947 (22)
Herrmann, John Oliver, 1947 (24)
Kendall, Robert Hall, 1947 (24)
Kruse, Henry John, Jr., 1947 (23)
Lewis, Dwight Edmund, 1947 (23)
Little, James Edward, 1947 (22)
Perryman, George Ira, Jr., 1947 (25)
Rankin, Norman Oliver, 1947 (23)
Snowden, James Russell, 1947 (30)
Wegener, Wilbert Frederick, 1947 (25)

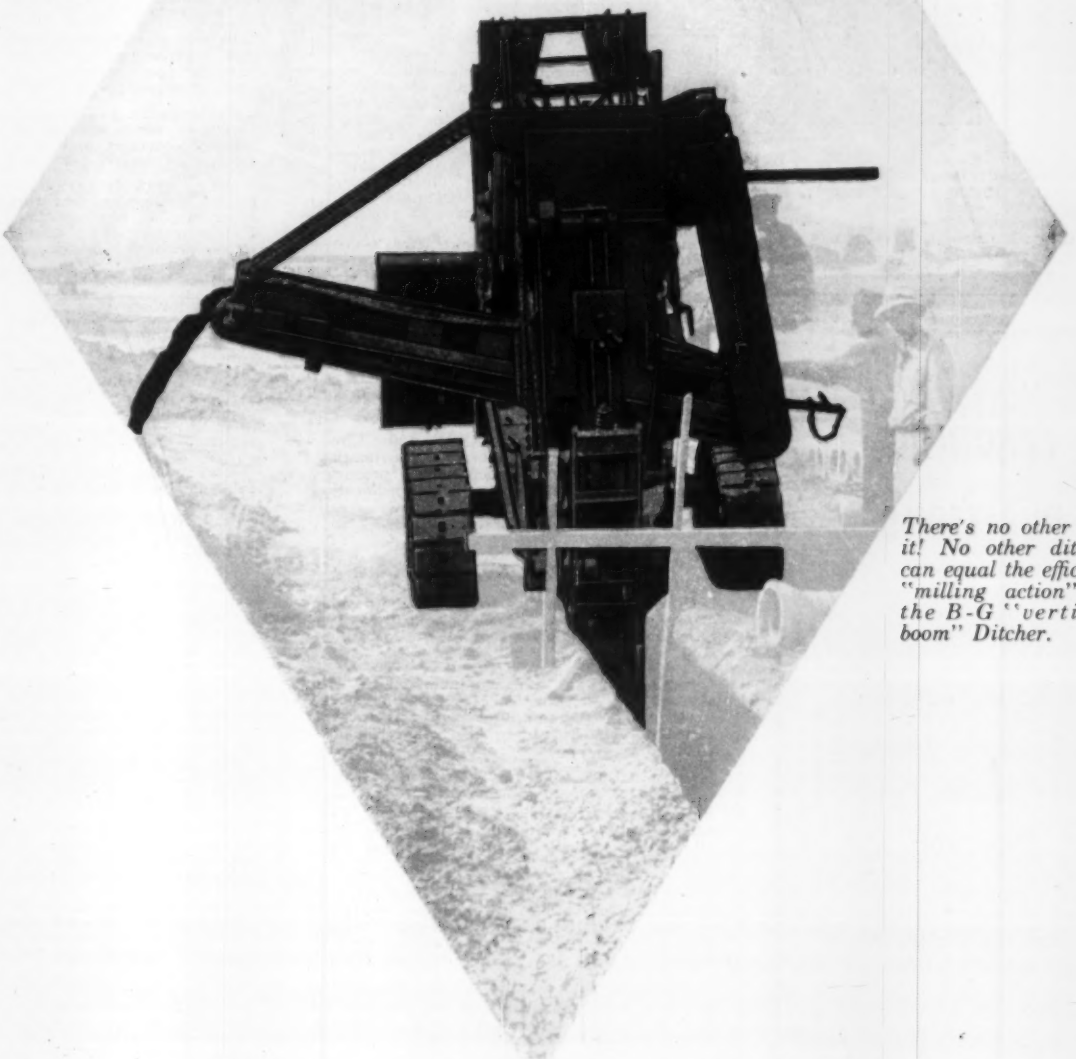
(*Continued on page 102*)

Barber-Greene

The Ditcher that Conquered CORAL ROCK!

Tough abrasive coral rock wasn't considered a good spot for a mechanical ditcher until the B-G Vertical Boom Ditcher first showed how the job could be done. Since that time, miles of trench have been cut in coral rock by B-G Ditchers, from the Florida flat lands to the Pacific's war-won islands. Naturally, with that kind of ability it is the preferred, moderate width, medium depth ditcher for working in everything from cemented gravel to sticky gumbo.

Like all B-G machines, it is engineered by experts to give long-time, cost-reducing service: the self-cleaning "kick-out" digging buckets on the vertical boom operate like a milling machine for sure cutting action: the automatic overload release gives positive protection, automatically resets itself: its short length, low over-all height and sure-footed crawlers give it maximum maneuverability. These are unique features that recommend this B-G Ditcher for tough going. Barber-Greene Company, Aurora, Illinois.



There's no other like it! No other ditcher can equal the efficient "milling action" of the B-G "vertical boom" Ditcher.

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Constant Flow Equipment

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Recent Books

(*Continued from page 86*)

MACRAE'S BLUE BOOK, America's Greatest Buying Guide and Hendrick's Commercial Register, 54th Annual Edition. MacRae's Blue Book Co., Chicago (18 E. Huron St.), 1947. 3740 p., illus., 11¼ × 8 in., cloth, $15. This annual reference volume lists all manufacturers in the United States under a detailed product classification. The listing under each product is alphabetical by company name. A complete alphabetical listing of company names, with capital ratings and local distributors, precedes the classified section. A 340-page Trade Name index is included at the back of the volume.

MATERIALS OF INDUSTRY. By the late Samuel Foster Mersereau, revised by Calvin G. Reen and Kenneth L. Holderman. McGraw-Hill Book Co., New York and London, 1947. 623 pp., illus., 8¼ × 5¾ in., cloth, $2.80. The fourth edition of this standard text covers recent developments in industry. Subject matter has been rewritten for better understanding by students in technical high schools and industrial and vocational schools. It offers a working knowledge of the main facts of industry, including distribution and production of raw materials and their general properties, transportation, conversion into commercial products, and economic importance.

SURVEYING, 3 ed. By H. Bouchard. International Textbook Co., Scranton (Pa.), 1947. 647 pp., illus., diagrs., charts, tables, 8 × 5 in., fabrikoid, $4.50. This standard textbook covers, in the first seven chapters, the fundamental operations of surveying, such as the measurement of angles, horizontal and vertical distances, and field operations with the transit. Subsequent chapters deal with triangulation, topographic and hydrographic surveys, municipal and other special surveys, errors, and astronomical observations. The adjustment of instruments is explained, and the new edition contains a discussion of the State systems of plane coordinates.

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Positions Available

CITY-COUNTY PLANNER to initiate and develop county master plan. Must be experienced in municipal work. Salary open. Location, Maryland. W-9233.

FIELD ENGINEER, civil graduate, 30–40, with at least 10 years' experience on building survey work, in industrial and power plant construction. Licensed engineer desirable. Salary, $5,000–$6,000 a year. Location, northern New Jersey. W-9244.

ASSISTANT PROFESSOR, 30–40, preferably with M.S. and several years' experience, to teach water supply, sanitation, and fluid mechanics. Salary, $4,000 a year. Starting September 1947. Location, New York, N.Y. W-9256.

FIELD SUPERINTENDENT, well grounded in all phases of construction for a monumental type of building. Duration, possibly one year. Salary, $110–$125 a week. Location, Washington, D.C. W-9271.

ESTIMATOR, civil, young, to take off quantities for architects' drawings and for pricing, for window company. Salary, $3,120–$3,300 a year. Location, New York, N.Y. W-9280.

CIVIL ENGINEER, graduate, with experience in storm drainage design, for rainfall and runoff computations, general hydraulic design, layout and arrangement of drainage systems for municipalities and airfields. Mostly office work with some field inspections. Salary open. Location, Maryland. W-9285.

CONSTRUCTION ENGINEER, single, civil or mechanical graduate, with 5 to 10 years' field experience, to supervise establishment and maintenance of exploration oil camps. Salary, $6,000 a year. Location, Venezuela. W-9286.

STRUCTURAL ENGINEER, with at least 10 years' design experience, to supervise industrial and chemical plant design. Salary, $5,000–$6,000 a year. Location, New York, N.Y. W-9314(*a*).

INSTRUCTORS IN CIVIL ENGINEERING, Two. One to teach mechanics of materials and reinforced concrete; another to teach mechanics. Location, Pennsylvania. W-9322(*a*).

STRUCTURAL ENGINEERS, SIX. Two should be capable bridge designers with at least five years' experience on reinforced and/or steel bridges. Four men to act as assistants to the designers and to do detailing, checking, and drafting work. Salary, $4,200–$5,400 a year; 44-hour week. Location, Pennsylvania. W-9338.

INSTRUCTOR TO ASSOCIATE PROFESSORS in Civil, electrical, and mechanical engineering. Salaries, $2,900–$4,400 a year. Location, Canada. W-9357.

CIVIL ENGINEER with minimum of 10 years' experience in the construction of hydroelectric dams. Will have complete charge of construction of three dams. Salary, $15,000–$20,000 a year. Location, South. W-9359.

STRUCTURAL ENGINEER, young, to assist the field engineer on large industrial building projects. Will take off quantities, issue requisitions, etc. Salary, $3,600–$4,800 a year. Work in Upstate New York. Headquarters, New York, N.Y. W-9360.

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ENGINEERS. (*a*) Superintendent or Project Engineer to take charge of building construction on industrial, oil, and chemical plants. Salary, $7,500 up, a year. (*b*) Chief Estimator with experieffce and capable of supervising estimating department for general building contractor. Location, Southwest. W-9363S.

STRUCTURAL ENGINEER, single preferred, with at least 2 years' building design experience, including some knowledge of structural welding. Two-year contract. Location, foreign. W-9383.

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CIVIL ENGINEER to take off quantities on brick, concrete, lath and plaster, for large apartment house construction project. Salary, $3,900 a year. Location, Brooklyn, N.Y. W-9389.

SUPERINTENDENT capable of taking full charge of concrete dam project. Must have had experience in this type of construction and have a following of supervisory personnel. Excellent opportunity for right man to share in an expanding organization. Salary open. Location, Midwest. W-9397.

ASSOCIATE PROFESSOR in civil engineering, to teach structural engineering and mechanics. Minimum starting salary, $4,100 for 9 months. Location, North Dakota. W-9399-R4298-D3547.

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For all the facts, see your Rex Distributor or write for a copy of Bulletin No. 480. Chain Belt Company, 1688 W. Bruce St., Milwaukee 4, Wis.

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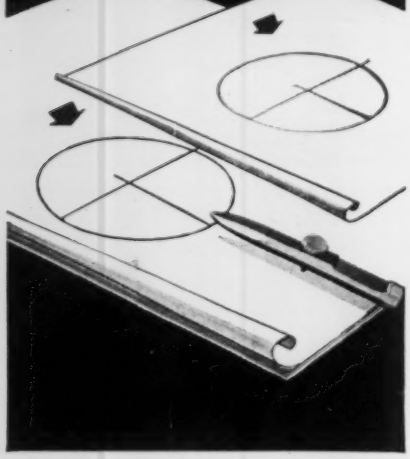

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Applications for Admissions and Transfers

(Continued from page 98)

UNIV. OF MO.

AYLING, ALBERT WALTER, JR., 1947 (25)
BARTON, RICHARD ALAN, 1947 (22)
BERRY, SAMUEL CARLYLE, 1947 (22)
CAHILL, DAVID FRANCIS, 1947 (26)
CARTMILL, EVERETT REO, 1947 (28)
KLAMM, CARL EUGENE, 1947 (25)
LAMAR, EDGAR LEE, 1947 (26)
MEYER, ROY CHARLES, 1947 (30)
PRICE, HERBERT DODD, 1947 (21)
SMITH, WARREN FRANK, 1947 (24)
SUMMERS, CLIFFORD LYNN, 1947 (25)
TAAFFE, GEORGE RICHARD, JR., 1947 (26)
WEBER, ARTHUR RUDOLPH, 1947 (22)

MONT. STATE COLL.

OMAN, GERALD EUGENE, 1947 (24)

UNIV. OF N. H.

POMEROY, RAY EUGENE, JR., 1947 (25)

N. Y. UNIV.

BASCOM, MANSFIELD, M., 1947 (23)
COHEN, ALVIN, 1947 (20)
DALY, MELVIN HENRY, 1947 (26)
DE PIERRO, JOHN JOSEPH, 1947 (24)
ESPOSITO, LOUIS SALVATORE, 1947 (23)
GARB, HAROLD, 1947 (21)
HOROWITZ, SIDNEY LEWIS, 1947 (24)
KUEHL, DONALD WALLACE, 1947 (28)
SANDERS, MORTIMER, 1947 (21)
SILVERBLATT, HERBERT, 1947 (25)
STETSON, JEROME ORRICK, 1947 (21)
WEBER, HENRY, 1947 (23)
WOHL, STANLEY, 1947 (23)

N. C. STATE COLL.

BOYER, WILLIAM WELCH, 1947 (24)
CHAPIN, HIRAM THOMPSON, JR., 1947 (26)
CLARKE, CHARLES EDWIN, JR., 1947 (27)
HERITAGE, THOMAS PRICE, 1947 (25)
HIGHSMITH, JAMES ALBERT, JR., 1947 (25)
SEAY, FLOYD STUART, JR., 1947 (22)

NORTHEASTERN UNIV.

BROWN, JAMES HENRY, JR., 1947 (23)
CHILDS, FREDERICK MERRILL, 1947 (24)
CLEARY, PAUL GERARD, 1947 (28)
CUMMINGS, EDWARD MORRILL, 1947 (26)
CUSACK, JOHN JOSEPH, 1947 (25)
DIRECTOR, PHILIP RONALD, 1947 (29)
DUTTING, JOHN BATES, 1947 (27)
FRIZZELL, PHILIP ARTHUR, 1947 (24)
MASSAD, PAUL MATTHEW, 1947 (25)
NEWCOMB, RICHARD WILLIAM, 1947 (25)
PIERCE, ROBERT FREDERICK, 1947 (21)
PISTORINO, CHARLES LEO, 1947 (24)
RECKTENWALD, WILLIAM RAYNOR, 1947 (25)
ROSA, JAMES MICHAEL, 1947 (25)
URBAN, ALFRED JOSEPH, 1947 (22)
VUONA, LOUIS PETER, 1947 (27)
WILTON, GEORGE HENRY, JR., 1947 (23)

NORTHWESTERN TECH. INST.

HUTTON, WINIFRED MARY ELIZABETH, 1947 (23)

NORWICH UNIV.

COHEN, JAY, 1947 (20)
DAY, JOHN WITHINGTON, 1947 (26)
HENRY, WALTER ALBERT, 1947 (23)

UNIV. OF NOTRE DAME

MEANEY, DANIEL DUNN, 1947 (22)

OHIO STATE UNIV.

HILL, JOHN LOWRY, 1947 (25)
KIMMICK, EDWARD JOHN, 1947 (28)
MCCORT, ROBERT EDWIN, 1947 (29)
SATTERFIELD, ROBERT EARL, 1947 (26)
WALKER, CARL CLAYTON, JR., 1947 (25)

UNIV. OF OKLA.

MEACHAM, JOSEPH JUNIOR, 1947 (27)

ORE. STATE COLL.

ANDERSON, LORNE E., 1947 (25)
ARENZ, RICHARD MOORE, 1947 (24)
BOCCI, LAWRENCE JULIUS, 1947 (27)
BOND, JOHN ALLEN, 1947 (22)
CAREY, GALE MILLER, 1947 (26)
COLE, PHILLIP LINDSEY, 1947 (25)
CROCKETT, JOHN FRED, 1947 (27)
DUGGAN, CHARLES WAYNE, 1947 (27)
EVANS, HARRISON MARTIN, 1947 (28)
GILPIN, WILLIAM RODERICK, 1947 (27)
HALL, EUGENE ALBERT, 1947 (29)
HATCHARD, RICHARD ERNEST, 1947 (26)
HILL, ROBERT NORMAN, 1947 (30)
HUTCHENS, RONALD HILDRETH, 1947 (29)
JOHNSON, WALTER FORREST, 1947 (28)
LEE, ROBERT LORA, 1947 (24)
LYNN, CHARLES, 1947 (26)
MADIGAN, FREDERICK HOWARD, JR., 1943 (28)
NALL, THOMAS ROGER, 1947 (26)
NEWBERG, WALTER ERNEST, 1947 (27)
NEWELL, WILLIAM ALLEN, 1947 (29)
RANDS, NORMAN HAROLD, 1947 (30)
REYNOLDS, EARL CHILDERS, JR., 1947 (24)
SHORT, DONALD RAY, 1947 (25)

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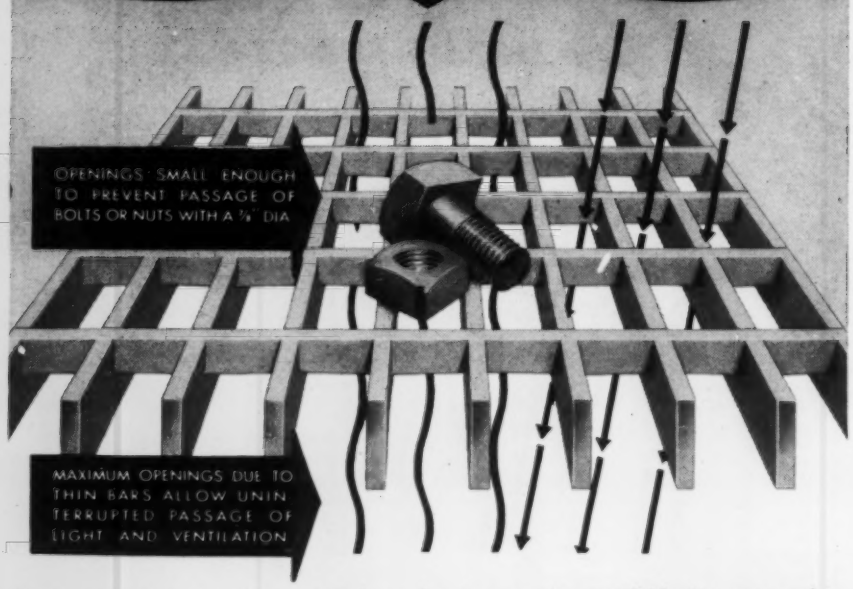
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STEINBRENNER, OTTO, JR., 1947 (26)
TIMMONS, CARL WELLS, 1947 (26)
WEBER, GEORGE HENRY, 1947 (29)
YARBROUGH, FREDERICK WILLIAM, 1947 (30)

UNIV. OF PA.

CURTIS, BENJAMIN TALMADGE, 1947 (29)
HAERING, JOSEPH HARRY, 1947 (24)
KWOK, CHIN FUN, 1947 (21)
PROSSACK, ALBERT HARRIS, 1947 (24)

UNIV. OF PITTSBURGH

HERTRICK, GEORGE THEODORE, JR., 1947 (23)
REES, DAVID BARKER, 1947 (23)

PURDUE UNIV.

ANDERSON, GLEN ROBERT, 1947 (24)
BAIR, ROYDEN STANLEY, 1947 (23)
BATMAN, WENDELL FRANCIS, 1947 (25)
BOSWELL, HOWARD LEONARD, 1947 (26)
BRANNAN, ROBERT WESLEY, 1947 (27)
BREWER, HERBERT LAWRENCE, 1947 (22)
CLARK, FORREST DAVID, 1947 (24)
DAVIS, SAMUEL NEAL, 1947 (25)
GARELICK, MARTIN, 1947 (23)
HOARD, JAMES JOHN, 1946 (22)
KENDALL, ROBERT CHARLES, 1947 (22)
LARSON, WALLACE ROY, 1947 (23)
LEE, WILLIS LESTER, 1947 (23)
MARKUS, HOWARD MILTON, 1947 (22)
MUEHLENBEIN, PAUL EDWARD, 1947 (22)
OSTERLING, ALLEN WARD, 1947 (21)
SIMPSON, FRED BAYNE, 1947 (29)
TRIPPET, BERNARR LYNN, 1947 (30)
UBER, PAUL ALAN, 1945 (22)
WARREN, HAROLD EMERY, 1947 (25)

ROSE POL. INST.

COOK, CLYDE EDWARD, 1947 (26)
ELSTNER, RICHARD CHESNEY, 1947 (23)
KING, JOHN FRANCIS, 1947 (25)
MITCHELL, RALPH ANDREW, 1947 (24)
NELLIS, WALLOVER HAMILTON, 1947 (25)
WADE, JAMES MICHAEL, 1947 (22)
WEIBEL, CHARLES GRAHAM, 1947 (23)

RUTGERS UNIV.

DE RENSIS, HENRY, 1947 (26)
KAROL, REUBEN HIRSH, 1947 (24)
SCHOTT, FREDERICK LUTHER, 1947 (27)
SINNAMON, GEORGE KIDD, 1947 (24)

UNIV. OF SANTA CLARA

MCKEE, JOSEPH FULTON, JR., 1947 (26)
O'CONNOR, ULYSSES STEPHEN, 1947 (24)
QUACCIA, JOHN BATTISTA, 1947 (25)

S.DAK. SCHOOL OF MINES & TECH.

DRIVER, WYNFRED CARROL, 1947 (22)
ENGLAND, JAMES ROSS, 1947 (23)
ENNENGA, JAMES LEWIS, 1947 (24)
MILLER, VIRGIL LEON, 1947 (23)
MORCOM, LEWIS WESLEY, 1947 (30)
REINECKE, DURWOOD DONALD, 1947 (23)

UNIV. OF S.CALIF.

CATALANO, MICHAEL LINCOLN, 1947 (23)

SOUTHERN METHODIST UNIV.

GRAHAM, JACK MONTGOMERY, 1947 (24)
SMITH, ROBERT JAMES, JR., 1947 (25)
TEIPEL, JOHN ALBERT, 1947 (23)

STANFORD UNIV.

AMES, LAWRENCE COFFIN, JR., 1947 (22)
CAHILL, RICHARD FRANCIS, 1942 (27)
DANIELS, LAWRENCE HILL, 1947 (26)
DYER, ALLEN CLAYTON, 1947 (24)
ECKELS, JAMES CAMERON, 1947 (23)
LUM, TIM MAN, 1946 (25)
MANGALABHANU, MADHAVAN, 1947 (28)
SMALL, SAM WHITE, III, 1947 (24)
TOM, FAY SUE, 1947 (22)
WILCOX, JAMES RUFUS, 1947 (23)

SWARTHMORE COLL.

ALBERTSON, ABNER HOWARD, JR., 1947 (21)
KEHO, CLIFF HUTCHINSON, 1947 (21)
SCRIVER, CHARLES HIRAM, 1947 (21)

SYRACUSE UNIV.

DOCKSTADER, EMMETT STANLEY, 1947 (23)
JACKSON, ROBERT CLARENCE, 1947 (26)
SADKIN, SEYMOUR, 1947 (22)

TEXAS TECH. COLL.

STRAWN, BENJAMIN DOUGLAS, 1947 (27)

UTAH STATE AGR. COLL.

BARTON, CLIFF SMITH, 1947 (28)
BOYSON, BERT WALTON, 1947 (29)
CASEMAN, AUSTIN BERT, 1947 (25)
DAVIS, STERLING, 1947 (27)
HANSEN, VAUGHN ERNEST, 1947 (26)
HICKMAN, LOUIS CARDON, 1947 (25)
LEATHAM, WARREN JENSEN, 1947 (26)

[illegible] Edward, 1947 (26)
[illegible] Daryl Baldwin, 1947 (29)
[illegible] Walter, Barrow, 1947 (27)
[illegible] Stanley Howard, 1947 (30)

UNIV. OF UTAH

Begley, Thomas Reid, 1947 (28)
Bronson, Rex Carl, 1947 (26)
Curtis, Warren Dale, 1947 (27)
Hansen, Jack Edward, 1947 (24)
Mavrakakis, John Nick, 1947 (22)
Mercer, Marne LeRoy, 1947 (26)
Moore, Robert French, 1947 (24)
Murdoch, Grant Robert, 1947 (23)
Smith, Glen Winter, 1947 (23)
Smith, Lamar Preece, 1947 (27)
Wallace, Gilbert Kimball, 1947 (23)
Zwick, William Evert, Jr., 1947 (24)

UNIV. OF VT.

Pierce, Franklin Kelley, 1943 (24)

VA. MIL. INST.

Anderson, Robert Edward, 1947 (24)
Beale, James Irving, III, 1947 (25)
Burbridge, Carl Samuel, 1947 (25)
Crim, Jacob Fitzpatrick, 1947 (25)
Findley, Delbert Lee, Jr., 1947 (26)
Floyd, Raymond Congdon, Jr., 1947 (24)
Freeman, Lewis DeWitt, Jr., 1947 (24)
Granger, Steuben Gilman, 1947 (24)
Irby, John Poindexter, III, 1947 (24)
Lamb, James Christian, III, 1947 (22)
Lawson, William Edward, Jr., 1947 (24)
Lindsay, William Freeman, 1947 (27)
Lohmar, Douglas William, 1947 (24)
Luck, Charles Merle, Jr., 1947 (26)
McVeigh, James Beverly, 1947 (24)
MacDonald, John Hugh, Jr., 1947 (26)
Meade, Richard Alva, 1947 (25)
Merchant, John Lloyd, 1947 (25)
Metcalf, Charles Theodore, 1947 (24)
Mills, William Charles, 1947 (22)
Morena, Salvatore Joseph Dominic, 1947 (24)
Overmyer, Richard Allen, 1947 (24)
Parker, George Ellis, Jr., 1943 (24)
Peyton, Tom Lewis, Jr., 1947 (23)
Poindexter, John Eldrige, 1947 (24)
Seay, Arthur Lucius, III, 1947 (24)
Sherrard, Robert S., 1947 (25)
Stevens, John Theurer, 1947 (27)
Sunday, Courtney Ryon, 1947 (26)
Sylvester, Allan Thorndyke, II, 1947 (20)
Warren, Joseph Turner, 1947 (23)
Wasdell, Edward Shephard, 1947 (26)
Watson, Earl, Jr., 1947 (25)
Watt, Robert Gilkeson, 1947 (25)
Whitehurst, Eldridge Augustus, 1947 (24)

VA. POL. INST.

Brownley, Richard Howerton, 1947 (25)
Kimbell, Richard Guy, Jr., 1947 (25)
Summers, Robert Alton, 1947 (24)

WASH. STATE COLL.

Dorway, William Dixon, 1947 (25)

WASHINGTON UNIV.

Verner, Robert Joseph, Jr., 1947 (24)

W.VA. UNIV.

Wilson, Helen Hope Sauerwein, 1947 (21)

UNIV. OF WIS.

Breuer, Richard John, 1947 (22)
Larsen, Elwood Melvin, 1947 (26)
Luck, Morton, 1947 (21)
Seidel, Gordon Frank, 1947 (21)
Wraight, Frank Donald, 1947 (28)

UNIV. OF WYO.

Allison, Wendell Glen, 1947 (28)
Bailey, Joseph Spencer, 1947 (26)
Brevdy, June, 1947 (22)
Chehak, Norbert Vincent, 1947 (25)
Crow, Herbert Maurice, 1947 (27)
D'Amico, John Raymond, 1947 (24)
Georgeff, Anthony Thomas, 1947 (24)
Haack, Frederick Leopold, 1947 (27)
Hall, Clair Eugene, 1947 (27)
Huston, Jay Joseph, 1947 (26)
McLaughlin, Wilson Francis, 1947 (30)
Mick, Kenneth Wiley, 1947 (23)
Mullens, Glenn Brook, 1947 (27)
Peterson, Lester Wilner, 1947 (31)
Roush, Frances Maxine, 1947 (22)
Sandstrom, Robert Allan, 1947 (28)
Wing, Wayman, C., 1947 (24)

YALE UNIV.

Balzer, Donald Joseph, 1947 (23)
Bronson, Gordon, 1947 (24)
Cahill, Harold Philip, Jr., 1947 (20)
Millstone, Edgar Donald, 1947 (23)
Ruotolo, Donn, 1947 (22)
Watkins, Marvin Clarence, 1947 (23)
Wakeley, Harold Marshall, 1947 (20)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

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provide FOUNDATIONS

The latest development in the art of foundation construction, the Drilled-In Caisson can be installed through any overburden into rock at any depth. . . . Individual caissons have been used to carry loads up to 1500 tons. Write for catalog. . . .

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The Drilled-In Caisson Corporation is equipped to make soil explorations by the latest methods; to furnish geological reports; and to provide soil mechanic determination.

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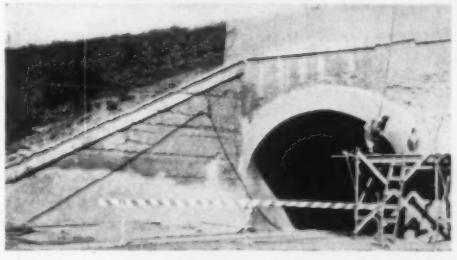


RAILROAD BRIDGE REPAIRED WITH "GUNITE."

This is one of the many bridges we have repaired with "GUNITE" for the R. F. & P. Railroad between Richmond and Washington.

This double-arch overpass built in 1904 was showing its age and after chipping away all disintegrated concrete and sand-blashing, mesh reinforced "GUNITE" at least 2" thick was applied to both arch barrels, end walls, and wing walls. The end walls in this case were also raised three feet with "GUNITE" to eliminate troublesome slipping of ballast.

"GUNITE" repairs to structures of this type will restore them for a great many years of useful, safe service.

Our bulletin B2300 describes many kindred jobs and scores of other uses of "GUNITE." Write for your free copy.

MANUFACTURERS OF THE "CEMENT GUN"

EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST, AS REPORTED BY MANUFACTURERS

New Marion Earth Mover

MARION POWER SHOVEL COMPANY of Marion, Ohio, has announced a new three-quarter cubic yard machine—the 33-M. With various front-end combinations, it is a shovel, dragline, clamshell, crane, and backhoe.

Features claimed for the new Marion include Marion air control, a greatly simplified machinery deck, simple change-overs for front-end equipment, the use of 22 ball and roller bearings. Only 12 gears are used in the entire machine. The shovel boom also serves as the boom for the backhoe. The crane boom point is adaptable without change for crane, clamshell, dragline, and pile driver service.

Marion air control covers all digging motions, gear changes and the operation of the steering clutches, propel brake, swing brake, dipper trip, and engine clutch. A maximum of 12 pounds pressure operates any air control lever.

Dual crowd, a combination of dependent and independent crowd, is standard, as is an independent high-speed boom hoist.

Pick-up Dumptruck

THE "PICK-UP DUMP," the first pick-up size dump truck with completely automatic hydraulic cab control, has been introduced by the National Truck Equipment Co. of Waukesha, Wis.

Designed for multiple uses in short hauls and small bulk handling by contractors, builders, fuel dealers, municipalities, industrial plants, landscape architects, and general truckers of all kinds, the "Pick-Up Dump" is the result of two years of engineering research and field testing by the Waukesha truck equipment supplier and manufacturer.

Easily adaptable to almost every make and body style of pick-up in the 1/2, 3/4, and 1-ton ratings, the Pick-Up Dump is available either as a complete unit with dump body or as a kit for the conversion of practically all standard pickups into Pick-Up Dumps.

Tested against loads in excess of its rated capacity, the new Pick-Up Dump has proved its durability and performance.

For further details contact National Truck Equipment Co., Waukesha, Wis.

Two-Wheel Scraper

A NEW TWO-WHEEL hydraulic scraper designed for high-speed use with large wheel tractors is now being manufactured by American Tractor Equipment Corp., 9131 San Leandro Blvd., Oakland 3, Calif. This new scraper is made in 3 sizes—4.5, 5.6, and 6.9 heaped yards, for International 19, Oliver 900, and other heavy-duty wheel tractors.

Like other ATECO scraper models, these new models for wheel tractors have a low center of gravity, independent front apron, and a rear apron that wipes the scraper bowl sides clean as load is dumped. The simple yoke design and absence of overhead structure give the operator a good view of his work from the tractor seat.

A special hitch assembly eliminates the front trucks of the scraper and enables the pulling tractor to carry part of the scraper load. It is self-loading and self-spreading. Travel speed is limited only by the speed of the tractor.

Scrapers may be had with either dual or single tires. Front truck assembly may be added so scraper can be operated in conventional manner with either crawler or wheel tractors.

For additional information write American Tractor Equipment Corp., 9131 San Leandro Blvd., Oakland 3, Calif., mentioning this notice.

Self-Cleaning Sludge Tanks

HAPMAN CONVEYORS, INC., of Detroit 21, Mich., present two self-cleaning sludge tanks. Self-cleaning is accomplished by pipe conveyors having synthetic rubber flights mounted on sealed pin chains.

These pipe conveyors will operate in any plane. A radical departure from ordinary tanks is the double "V" bottom which permits rapid sludge settling and quick removal. A series of five baffles retards the coolant flow uniformly over the tank area providing maximum sludge-settling capacity.

A single sprocket with shear pin mounted on a combination drive and take-up assembly represents the only fixed moving part. The chain elsewhere in the circuit follows the bent pipe in several planes.

Power required to operate conveyors is small, 1/6 hp for the Junior size and 1/3 hp motor for the Standard size sludge tank.

These tanks are suitable for any non-corrosive sludge which will readily settle. Quench tank scale, machine tool coolant settlings, and abrasive precipitates are typical materials handled. Temperature is limited to 270 deg. F. The Junior size has a coolant capacity of 400 gal. while the Standard size capacity is 3,200 gal.

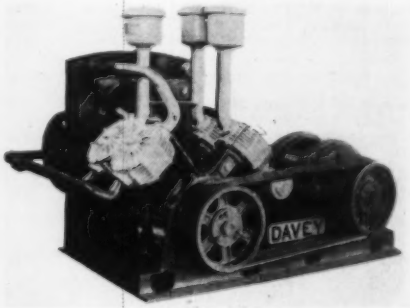
New Line of Air Compressors

THE DAVEY COMPRESSOR CO., Kent, Ohio, has just announced a complete new line of two-stage, air-cooled industrial air compressors of 60–105–160–210–315 cfm capacities.

Known as "Air Chief Industrials," these machines feature Permanent Peak Efficiency Valves and the new Davey Equi-Balanced crankshaft. The latter is reputed to reduce compressor vibration to a previously unachieved minimum. Its use, coupled with employment of modern rubber vibration mounts, makes possible the elimination of heavy mounting bases and facilitates the ready removal of units from one location to another.

Air Chief Industrials are available in four types: (1) Base Compressors, (2) Stationary units with base ready for installation of customer's electrical equipment, (3) Departmental Compressors powered by a-c motors, (4) Departmental Compressors with d-c motors.

For further details write to the manufacturer.



Caterpillar Bulldozers

CATERPILLAR TRACTOR CO., Peoria, Ill., has announced the manufacture of four sizes of Hydraulic controlled bulldozers, newcomers to the Company's line of earth-moving products.

Designed exclusively for use with "Caterpillar" diesel D8, D7, D6, and D4 track-type Tractors, the new bulldozers are compactly constructed and combine the built-in ruggedness and working ability of the "Caterpillar" bulldozers with the advantages of a closed hydraulic system.

Features of the "Caterpillar" hydraulic system are front mounted, positive action, balanced vane pump, integral with tank and operating valves; manually operated 3-position valve with "raise," "lower," and "hold" positions; rapid blade action offering unexcelled blade adjustments to meet varying work conditions; heavy steel guard protecting front-mounted hydraulic pump housing.

Both straight and angling type blades are offered in bulldozers for D6, D7, and D8 models. Only the straight type blade is now available for the D4 model.

NO ADMITTANCE! to unwanted water

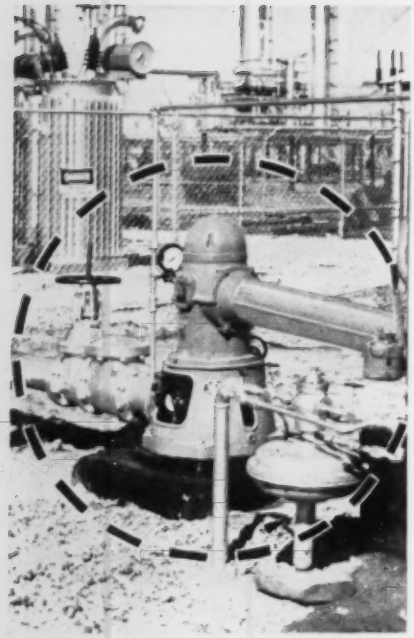
Here is a low-cost way to gain adequate drainage and eliminate the danger of high water flooding valuable property. Use ARMCO Drainage Gates to permit free outflow with positive action to stop backflow.

These gates have ample strength and durability. They are ideal for drainage, flood control, sewer outfalls, irrigation work or wherever else backwater is a hazard. What's more, ARMCO Gates will serve for years without upkeep or repairs.

There is a size and type of ARMCO Gate to meet every drainage requirement — flap gates that open and close without supervision; slide gates for light and heavy duty, and radial gates for maintaining constant water levels. They can be adapted to circular or rectangular openings in sizes ranging from 8 to 120 inches in diameter or from 8 to 96 inches square. Installation is quickly and easily accomplished by a small, unskilled crew.

You'll find ARMCO Drainage Gates are a sound investment in protection and efficiency. Write for prices and complete design data. Armco Drainage & Metal Products, Inc., 1905 Curtis Street, Middletown, Ohio. Offices in principal cities.

ARMCO Drainage Gates, Model 102, installed on a levee project in Oregon. These flap type, cast steel gates permit free outflow with positive action to stop backflow.



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To you, the reader, the above picture is just one of hundreds of Layne Well Water Systems that are now serving oil fields, refineries and pumping stations. But to us, it is a symbol of approval by one of the world's largest and most important industries. Furthermore, this picture serves to symbolize a record of nearly seventy years of successfully matching the highest quality materials with honest craftsmanship.

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New Tournapull for Big Production Earthmoving Jobs

R. G. LeTourneau, Inc., Peoria, Ill., has announced another model in its new line of high-speed, electric-controlled earthmoving equipment—the 35-ton capacity Model B Tournapull.

Powered by a 225-hp diesel engine, this prime mover is available for use with two sizes of scrapers—the new E-35 Carryall, having a 35-ton (26.1 yards, struck) capacity, or the 25-ton E-25 Carryall (16.5 yards, struck) capacity. Designed for fast hauling, the unit has 4 speeds forward, 2 in reverse, and travels up to 15 miles per hour.

New developments in the design of the Tournapull include electric control, Tournamatic constant-mesh transmission and Tournamatic differential.

Other outstanding features on the new Model B Tournapull include positive power steering and tapered bead tires.

Based on good working conditions the Model B Tournapull with 35-ton Carryall is capable of moving 347 yards of common earth per hour on a 500′ one-way haul.

High-production capacity, speed, and maneuverability make the Model B Tournapull especially versatile on big yardage jobs like dams, heavy stripping, major road construction, airports, levees, and other large-size projects involving huge production earthmoving.

New Type Compressor

Mr. James M. Long of Associated Engineers, Inc., Las Vegas, Nev., announces the completion of tests on the New Oscillating Compressor. This compressor is revolutionary in design.

Among the outstanding features is that it has only four major driving parts. The compressor produces an unusually large volume of air with a comparably low horsepower motor operating at a low speed. Mr. Long states that vibration and noise, due to its unique design, drive, and balance, have been eliminated. In the working model, the bore is 10 in. in diameter by 9 in. deep, each cylinder is divided into four compartments by means of two stationary vanes and one oscillating rotor fixed to the rotor shaft, thereby rendering eight cylinder performance. At every revolution of the crankshaft, eight power outputs are produced, the equivalent of the displacement of both cylinders. At 235 revolutions per min, the compressor has an output of over 500 cu ft per min, of free air at room temperature. The output of this compressor is said to be about ten times that of a comparable size conventional compressor. The weight of the model is 350 lb.

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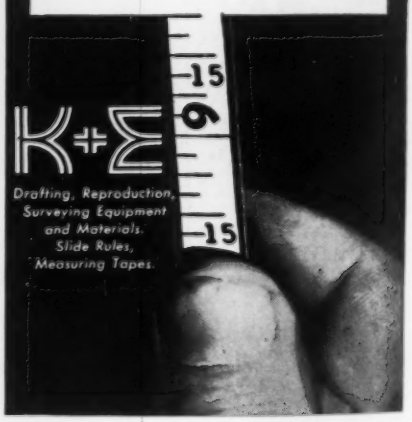

This compressor can be adapted to ventilation, refrigeration, hydraulic and stage booster pumps, and all types of jobs using compressed air. It will be made in all standard sizes.

New Sealing Compound

A NEW SUBSTANCE called Agraseal has been perfected by Tamms Silica Company, 228 N. La Salle St., Chicago 1, Ill., which is designed to do a protective and sealing job on all porous masonry surfaces. The material not only does a waterproofing job, but also beautifies surfaces to which applied. It is available in white, ivory, cream, light buff, natural stone grey, sunny yellow and light green. The only time a second coat is desirable is when you want stronger color value or a smoother finish.

Agraseal is easily applied with ordinary scrub brush. When first applied, material penetrates deep into open pores. When it sets, a positive seal is established which withstands dampness, water, steam, alkali, sun, smoke, heat, cold, frost, ice. Agraseal is sold only through block manufacturers. It comes in powder form and mixes with water only. One gallon covers 50 sq. ft. for the first coat—100 to 150 sq. ft. when second coat is applied.

New Cartographic Camera

FAIRCHILD Camera & Instrument Corporation, Jamaica, N.Y., is making limited deliveries, with production increases scheduled on its new Cartographic Camera, designed to provide aerial photographs of rigid precision.

The 9" × 9" photos meet requirements for topographic and planimetric maps needed in crop and flood control, soil conservation, geological exploration, highway expansion, urban and rural improvements, coastal defense, and other widespread aerial mapping programs.

Of simple, compact design, this new unit meets precision camera specifications of the U.S. Department of Agriculture and the U.S. Geological Survey. Its focal length, field of view, negative size, construction, tolerances, and other specifications are such as to permit ready employment of its negatives in the multiplex projector and other stereoscopic plotting instruments.

The Cartographic Camera has several original features. The instrument, which may be operated either automatically or semi-automatically, has two cones, lying one within the other. The inner cone—the optical heart—contains the focal plane and the optical system, and is readily removable as a complete unit for calibration by the U.S. Bureau of Standards as part of Fairchild production procedure. The outer cone contains all operating mechanisms, readily accessible for ease in servicing. Front and rear lens elements may be removed for cleaning and inspection without disturbing collimating, as dowels are provided as an index for accurate alignment when the lens is replaced.

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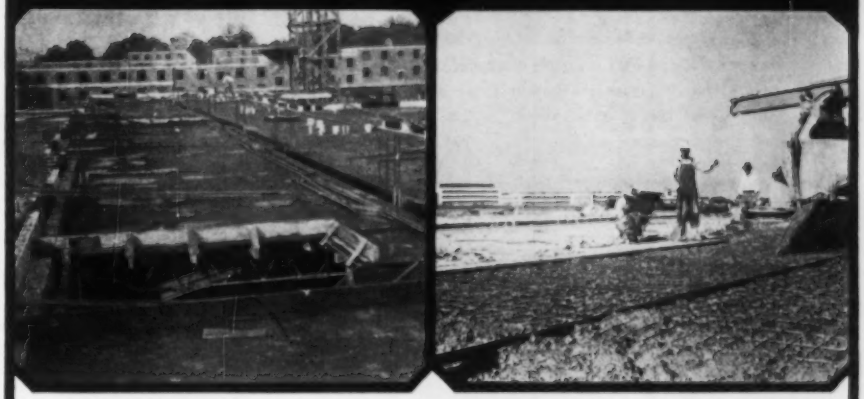

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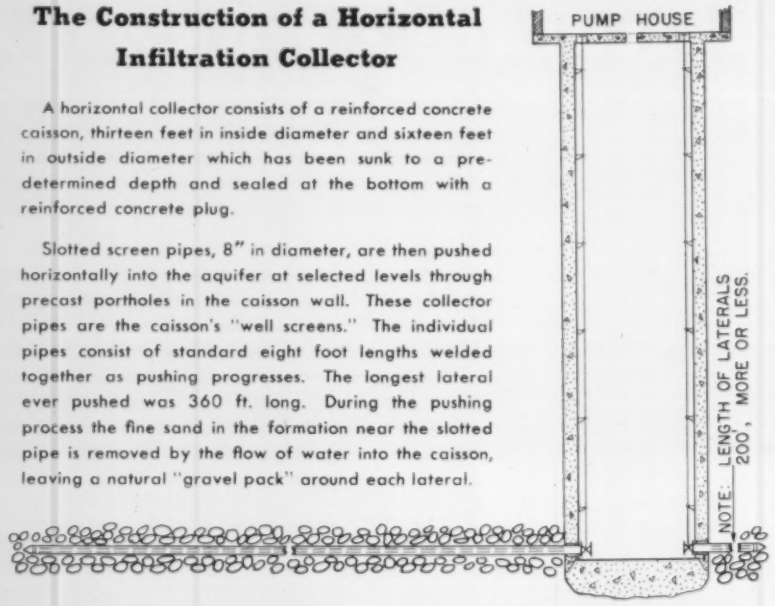

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New Model Line Marker

THE NEW MODEL NEWAYGO LINE MARKER is designed to provide a speedy, efficient, and economical means for marking street crossings, parking spaces, dividing lines and intersections on city streets and highways.

The unit is light and easy to handle; reducing to a minimum the man-hours required for the work. The unit can be taken apart for cleaning in five minutes, and can be completely reassembled as quickly.

This line marker is a simple unit, with no spray nozzles, pumps, or hose to clog or get out of order. The painting liquid is held at a fixed level in the reservoir in front of the paint tank by vacuum. From here the paint is picked up by an idler wheel, which dips into it and spreads the paint onto the marking wheel, which in turn rolls the paint evenly on the street surface. This correctly engineered mechanism saves large quantities of paint.

Further information on this line marker may be obtained from the Newaygo Engineering Co., Muskegon St., Newaygo, Mich.

Electric Impact Tool

INGERSOLL-RAND announces a New Universal Electric, All-Purpose Impact Tool. Using standard attachments, it will apply and remove nuts—drill—ream—tap—drive and remove screws—drive and remove studs—extract broken cap screws and studs—run wire brushes—do hole saw work—drill brick and masonry—drive wood augers.

This new machine is designated as Size 4U. It weighs only $6\frac{1}{2}$ lb., has an overall length of $10\frac{1}{2}$", a free speed of 2,000 rpm, and delivers 1,900 rotary impacts per minute under load. It is powered with a specially designed reversible, universal, electric motor (3 amp) that operates on 110-Volt, ac-dc current.

Further details will be furnished by Ingersoll-Rand Company, 11 Broadway, New York, or any of its branch offices and distributors.

New Denison Multipress Midget

ESPECIALLY DESIGNED for pressing requirements between 200 and 2,000 lb. ram effort, the new Multipress Midget offers all features of the larger Multipresses—plus small, compact size and low cost.

The Multipress Midget is ideally suited for multiple or "gang" installations and for successive operation requirements. One centralized power source will operate up to 12 units. When more than one Midget is used, each unit has individual pressure adjustments. The Midget may be operated in any position, and is easily adaptable to other hydraulic machinery as an accessory unit for pressing, clamping, feeding, and countless other production tasks.

Descriptive bulletin containing complete data on this new Midget is available on request, from The Denison Engineering Co., Columbus 16, Ohio.

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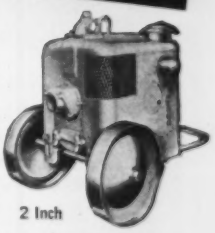

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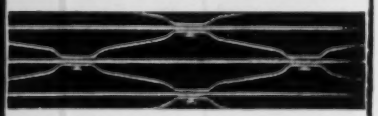

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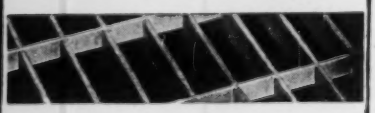

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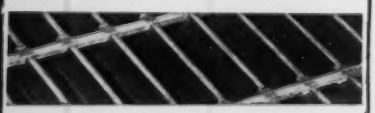

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REVISED ENGINEERING INSTRUMENT CATALOG—A newly revised edition of the 50-page illustrated catalog describing the complete line of Gurley engineering instruments has been published by W. & L. E. Gurley of Troy, N. Y. The catalog includes detailed analyses of Gurley transits, engineers' levels, precise leveling rods, alidades and topographic instruments and equipment. Hydraulic measuring instruments, water level recorders and indicators, field supplies, and wind instruments are also discussed. Glass reticles, an exclusive Gurley development in surveying instrument design, replacing the platinum wire reticle are illustrated and described as are other features of Gurley transits. Several reticle pattern designs are shown from parallel horizontal and vertical lines, combined with cross-lines for triangulation and stellar observation, to solar reticles for centering the sun's image. Copies of the catalog, No. 50, are available on request to W. & L. E. Gurley, Troy, N.Y.

TILE AND CAST IRON CONDUIT SYSTEMS—Specifications and descriptions of various basic types of tile and cast iron conduit for underground steam, return, hot water and oil lines are the subject of a 4-page standard file-size folder recently published by the Ric-wiL Company, Cleveland, Ohio. A practical aid to architects and engineers, the folder contains engineering data, showing trench dimensions and pipe locations recommended for each size and type of conduit. Tables also give the capacities of the various conduit types and sizes for combinations of up to five pipes. Illustrations and cross-section drawings of Ric-wiL tile and cast iron conduit and their accessories also are included. Copies of this folder (Form 4704) may be obtained without charge by writing the Ric-wiL Company, Cleveland, Ohio.

PUMP CATALOG—A new catalog B-1146 covering their CS, vertically split case multi-stage pumps is announced by Economy Pumps, Inc., Hamilton, Ohio. These pumps are built for larger capacities ranging from 50 to 200 gallons per minute. These pumps generally used in direct connection with electric motors, may also be driven with steam turbines, gasoline engines, or by chain or belt drive arrangements. They are restricted to clear liquid pumping and are especially applicable to boiler feeding, ice water circulation, brine circulation, sprinkling, general water supply, and pneumatic water systems.

AIRCO REPRINT—A 12-page reprint of an article entitled "Flux-Injection Cutting of Stainless Steels," has been announced by the Air Reduction Sales Company. The article covers the fundamentals, capacities, and advantages of the revolutionary Flux-Injection Method. Copies may be obtained by writing Air Reduction Sales Company, 60 East 42nd St., New York 17, N.Y., or the Airco sales office nearest you.

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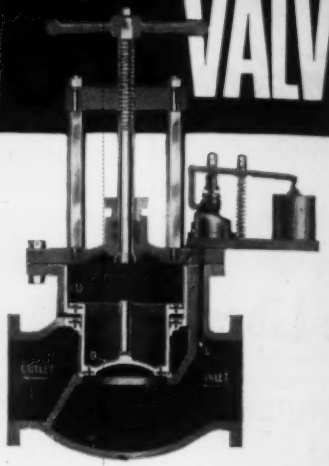

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